ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

The physico-chemical study of surface water from Waluj Industrial area near Aurangabad city of Maharashtra, India.

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ABSTRACT

The water quality assessment of water from Waluj has been repored. In this paper atmospheric temperature, water temperature, humidity, rainfall, pH, acidity, alkanility D. O, total nitrogen, sulphate, phosphates, chlorides total solids etc is monitored for two years 2010-2011, & 2011-2012 The seasonal variation in these physico-chemical parameters has been discussed.

Keywords: Water Quality; Surface water; Water Pollution; Waluj Industrial area

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ISSN: 0975-8585

INTTRODUCTION

Water plays an important role in respiration more so because protoplasm is composed of large quantity of water besides other constituents. Fresh water ecosystems are inland waters that low concentration of salts (L500 Mg/L). Oxygen concentration is high in lotic waters due to turbulence and mixing with air. In lentic waters free carbon dioxide plays an important role in regulation of pH. In well mixed waters, the pH and carbon dioxide concentration are uniform from surface to bottom.

Characteristic of the physical environment such as pH, temperature, available nutrients like Nitrogen, Phosphorous, Iron, Silica and Salinity, set the boundary conditions for the abundance and diversity of protozoa within a given habitat.

Organisms are functionally indivisible and cannot be split into conventional compartment of physiology, morphology, behavior etc. Each of these is but an aspect of the organism. Thus an organism is an interaction between complex self-sustaining physico chemical systems. There are varius papers appeared which monitored physico-chemical parameters from marathwada region [1-5] but very less or almost no work has been reported regarding water quality of waluj surface water.

The water flows North to South along the city of Waluj, near Aurangabad. It carried the wash off and industrial discharges from the neighbouring areas. Hence it is necessary to monitor the water quality of this river[6-7].

MATERIAL AND METHODS

Water samples were collected from about 15 Cm, below the surface of water in wide mouthed screw capped, air tight and opaque polythene containers. The samples were collected fortnightly from June 2010 to May 2012. The samples were collected on 1st and 15th of every month around 9.00 a.m. The atmospheric and water temperature was recorded with the help of digital portable kit. The digital portable kit is an excellent, instrument for field operations. It has got automatic decimal, positioning polarity indication as well as low battery indication which eliminates manual errors. The data of humidity and rainfall was collected from Metereological department, Chikalthana, Aurangabad. The pH of the sample was recorded with "Systronic portable pH Meter". Dissolved Oxygen, Acidity, Total alkalinity, Hardness nitrogen, Sulphate ion, phosphates, Total solids etc has been determined as per the procedures given in the literature[8-9]

There are three seasons during a year in this region namely summer (February to May), Monsoon (June to September) and Winter (October to January). The summer season is characterized by clear sky, with relatively longer duration of the day and more intensity of light. During monsoon the sky is cloudy, humidity is relatively more and the temperature is moderate to high. The winter has relatively brighter days with clear sky, and the lesser duration of the day. As all ecological factors are influenced by the duration and intensity of sunlight, humidity, atmospheric and water temperature, various physic-chemical variables were studied during the present study over a period of two years.

Atmospheric Temperature: The effect of temperature as an environment factor is evident, however its influence is not direct.The pattern of fluctuation of the atmospheric temperature, at the three sampling stations, over a period of two years is shown in table 1. The annual range of temperature was 16.4 – 31.2°C during 2010-11 and 15.2-31.1% during 2011-12 In 2010-2011 the range of temperature in monsoon was 22.2 – 27.4°C, in winter 15.0 – 28.0°C and in summer 16.2 – 31.2°C, while during the year 2011-2012 the range was 22.3 - 29.2°C, 16.0 - 24°C and 17.6 – 31.5°C in monsoon, winter and summer respectively. During 2010-11 the range of temperature was narrow in monsoon (0.5°C) wide in winter (13.0°C), much wider in summer (16.2°C). During 2011-2012 the range was narrow and almost identical in monsoon and winter (6.9°C and 8°C) respectively, while in summer it was much wider (13.9°C). The range of temperature was narrow in monsoon (4.4°C), wide in winter (9.8°C) and wider in summer (14°C) during 2010-11. During 2011-2012 the range of temperature was 3.6°, 8°C and 15.8°C in monsoon, winter and summer respectively. In general the monsoon has moderate temperature with narrow range, winters with wide range and summers with much wider range.

ISSN: 0975-8585

Table 1 : variations in atmospheric temperature (°C) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	20.9	22.2	20.8	25.4	26.0	24.8	27.4	25.2
	**	24.8	28.2	27.6	26.2	29.3	32.1	32.6	32.4
Winter	*	28.2	20.5	20.1	21.1	20.0	18.0	17.1	16.8
	**	29.9	30.2	27.7	28.3	25.6	28.3	25.4	25.5
Summer	*	16.2	17.2	20.4	28.7	29.1	31.2	30.7	31.0
	**	34.2	34.8	36.2	38.4	39.7	41.4	42.2	42.6

Table 2 : variations in water temperature (°C) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	17.1	19.3	17.4	23.5	23.1	21.6	24.2	22.4
	**	21.6	25.1	24.9	23.4	23.6	26.4	28.3	27.6
Winter	*	15.2	15.4	17.3	14.8	12.1	24.7	12.9	13.3
	**	25.8	27.1	23.6	24.1	21.7	24.6	22.2	22.1
Summer	*	12.9	14.7	17.2	24.9	25.8	28.3	26.9	27.2
	**	31.4	31.2	32.9	34.5	35.3	38.6	39.3	39.0

Water Temperature : The water temperature was consistently lower than the atmospheric temperature by 1 - 3°C throughout. The patterns of fluctuations of water temperature is shown in table 2. A number of biological processes are affected, by thermal values in acquatic areas. Feeding, growth, respiration, reproduction and general physical activities are often altered by temperature extremes_Maximal or Minimal. Growth rate to a great extent is controlled by temperature because various metabolic processes governing growth react to critical temperature. The temperature plays a very effective role in chemical reactions an population fluctuations. During the present study water temperature was consistently lower than the atmospheric temperature.

Humidity: The range of percentage of humidity during 2010 – 11 was 15 – 85%, during 2011-12 it was 20 – 92%. The range of percentage of humidity during 2010-11 was 41 - 62%, 61 - 84% and 15 – 65% in winter, monsoon and summer respectively. Thus, the range of humidity was narrow in winter, wide in monsoon and much wider in summer being 21%, 23% and 50%. During 2011-12 the range in winter and 35 – 83%, in monsoon 66 – 92% and in summer 20 – 69%. Thus, the range was narrow in monsoon, wide in winter and more wider in summer being 26%, 48% and 49% respectively. The details of the fluctuations are shown in table 3.

Table 3 : variations in humidity (%) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	78	62	73	68	79	85	73	81
	**	68	90	74	80	82	92	92	92
Winter	*	50	43	51	59	60	51	41	49
	**	82	75	62	34	43	46	82	62
Summer	*	50	55	65	30	15	56	64	39
	**	64	71	20	31	31	22	26	22

Rainfall: The total rainfall recorded during 2010-11 was 394-6 mm and during 2011-12 584.4 mm. The seasonwise analysis of the rainfall showed that it was at its peak during monsoons and least during summers of both the years The details of the rainfall are shown in table 4.

ISSN: 0975-8585

Table 4 : variations in Rainfall (mm) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	-	-	-	-	0.2	-	-	-
	**	1.2	9.1	-	-	3.9	9.5	63.5	41.2
Winter	*	0.4	-	-	-	-	-	-	-
	**	39.4	-	30.6	-	-	-	-	-
Summer	*	1.1	-	-	-	-	-	-	-
	**	-	-	-	-	-	-	-	-

pH: The acid or the base character of any aqueous solution can well be defined by means of a single variable the hydrogen ion activity.

During the present study the annual range was 6.8 – 7.8 during both the years It was maximum in winter and minimum in monsoon during both the years. A seasonwise analysis shows that the range during 2010 – 2011 was 6.8 – 7.4, 7.0 – 7.8 and 6.6 – 7.1 in monsoon, winter and summer respectively. The range was narrow in summer (0.5) wide in monsoon (0.6) and relatively wider in winter (0.8). During 2011-2012 the range was 6.7 – 7.3, 7.4 – 7.9 and 6.8 – 7.4 in monsoon, winter and summer respectively. The range is narrow in winter (0.5) wide and identical in monsoon and summer (0.6).

Acidity: The acidity in natural water is primarily due to dissolved carbondioxide. However, in water polluted by industrial water it is because of mineral acids. During the present study an amount of Co_2 was recorded occasionally and that too in very low quantities. It was present in 2nd fortnights of May and June during 2010-11, while during 2011-12 it was present in 1st fortnight of June and 1st and 2nd fortnight of April and May. The range was 0.25 – 0.50 PPm during both the years.The details of the acidity recorded is shown in table 6.

Total Alkalinity Alkalinity is the contribution of hydroxide, carbonate and bicarbonate. Numerically it is an equivalent concentration of titeratable base and is determined by titration with a standard solution of strong acid, to certain equivalence points as given by the indicator solution. Natural waters contain appreciable amounts of carbonate and bicarbonate alkalinities.The range of total alkalinity recorded in 2010-11 and 2011-12 was 84.90 – 108.15 ppm and 80.04 – 105.70 ppm respectively. The seasonwise analysis of total alkalinity showed that it was maximum in monsoons and minimum in winters of both of the years. The range of total alkalinity was 30.11 – 44.77 ppm, 12.66 – 32.11 and 12.44 – 21.44 ppm in monsoon, winter and summer respectively during 2010-11. The range was narrow in summer (9.0 ppm), wide in monsoon (14.66 ppm) and wider in winter (19.45 ppm). During 2011-12 the range in monsoon was 92.78 – 110.70 ppm, in winter 98.04 – 112.19 ppm. And in summer 89.90 – 110.25 ppm. The range was narrow in winter (14.15 ppm), wide in monsoon (17.92 ppm) and wide in summer (20.35 ppm). The pattern of fluctuations is shown in the table 7

Table 5 : variations in (pH) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	6.9	6.8	7.2	6.8	7.1	7.3	7.4	7.2
	**	6.7	6.8	7.0	7.2	7.3	7.1	7.2	6.9
Winter	*	7.0	7.6	7.4	7.2	7.5	7.6	7.4	7.8
	**	7.5	7.4	7.6	7.8	7.5	7.8	7.4	7.9
Summer	*	6.6	6.8	7.1	7.0	6.7	7.0	7.1	6.8
	**	6.8	6.9	7.0	7.2	7.4	7.1	7.3	7.1

ISSN: 0975-8585

Table 6: variations in Acidity (PPM) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	-	0.25	-	-	-	-	-	-
	**	0.25	-	-	-	-	-	-	-
Winter	*	-	-	-	-	-	-	-	-
	**	-	-	-	-	-	-	-	-
Summer	*	-	-	-	-	-	-	-	0.50
	**	-	-	-	-	0.25	0.25	0.50	0.50

Table 7 : variations in Total Alkalinity (PPM) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	30.11	34.21	42.61	44.77	43.91	41.74	39.42	38.63
	**	92.78	94.66	95.12	99.12	106.31	110.70	99.86	92.32
Winter	*	32.66	32.11	28.33	26.71	22.14	30.76	12.66	14.13
	**	112.19	110.14	102.55	97.87	111.86	101.21	98.04	99.22
Summer	*	12.44	15.91	17.42	20.12	21.32	21.44	19.43	20.76
	**	89.90	91.12	92.04	95.47	102.41	110.25	98.89	107.13

Total Hardness: Hardness of water is caused by the bivalent metallic ions as cation Ca, mg, Sr, Fe, Mn and anions HCO_3, So_4, Cl, NO_3 and SIO_3. Temporary hardness is caused by the presence of HCO_3 of Ca and mg. Permanent hardness is mostly due to SO_4. The annual range of total hardness at was 60.2 – 94.4 ppm and 60.0 – 92.6 ppm during 2010-2011 and 2011-2012 respectively. Seasonal analysis showed that the hardness recorded during present study was maximum during summer and minimum during winter of both the years. The range was 83.2 – 90.7 ppm, 62.6 – 86.4 ppm and 66.6 – 94.8 ppm in monsoon, winter and summer respectively during 2010-11. The range was narrow in monsoon (7.5 ppm), wide in winter (23.8 ppm) and wider in summer (28.2 ppm). During 2011-12 the range in monsoon was 58.0 – 65.2 ppm, in winter 56.8 – 62.8 ppm and in summer 64.4 – 94.4 ppm. The range was narrow in monsoon and winter (7.2 ppm – 6.0 ppm) and much wider in summer (32.0 ppm). Table 8

Table 8 : variations in quantity of total Hardness (PPM) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	83.2	89.4	84.5	86.8	90.7	89.8	90.2	86.4
	**	59.2	58.0	63.6	64.2	64.8	65.2	64.6	59.5
Winter	*	62.6	63.4	66.7	82.3	84.7	85.1	86.4	80.2
	**	57.1	56.8	58.3	59.2	61.3	60.4	61.5	62.8
Summer	*	66.6	68.4	72.3	76.8	81.6	88.2	94.8	92.4
	**	68.2	64.4	80.7	93.8	93.6	82.4	88.9	94.4

Dissolved Oxygen: The annual range of dissolved oxygen was 6.12 – 16.14 ppm during 2010-11 and 4.9 – 11.50 for the year 2011-12. Seasonwise analysis showed that the dissolved oxygen was at its peak in winter, less in summer and least in monsoon during both the years. The range of dissolved oxygen in monsoon was 6.38 – 8.86 ppm, in winter 8.2 – 16.46 ppm and in summer 6.02 – 14.40 ppm during 2010-11. The range was narrow in monsoon (2.48 ppm), wide and identical in winter and summer (8.26 and 8.38 ppm) respectively. During 2011-12 the range was 4.96 – 9.02 ppm, 8.9 – 11.68 ppm and 4.52 – 9.72 ppm in monsoon, winter and summer respectively. The range was narrow in winter (2.78 ppm), wide in monsoon (4.06 ppm) and much wider in summer (5.20 ppm).The details of the fluctuations of dissolved oxygen are shown in table 9

ISSN: 0975-8585

Table 9 : variations in Dissolved Oxygen (PPM) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	6.38	7.02	6.89	7.49	7.97	8.21	8.86	8.14
	**	5.02	4.96	7.21	6.89	7.80	9.02	8.90	9.02
Winter	*	5.71	6.24	6.66	7.31	8.12	7.79	8.50	8.91
	**	8.9	9.12	9.45	9.83	10.12	11.24	10.98	11.68
Summer	*	6.84	6.02	7.26	8.92	9.40	12.89	14.40	13.91
	**	4.52	5.71	6.76	7.83	6.92	8.83	9.72	9.12

TOTAL NITROGEN: Nitrogen estimation is significant to asses the quality of water. Presence of organic and ammonia nitrogen called total nitrogen is the chemical evidence of organic pollution particularly of animal origin. The range was 0.96 – 1.35 and 0.33 – 1.08 ppm for the year 2010-11 and 2011-12 respectively. A seasonwise analysis of the total nitrogen showed that it was at its peak in winter and least in summer during 2010-11. During 2011-12 it was maximum in monsoon and minimum in winter. The total nitrogen ranged between 1.09 – 1.29, 1.02 – 1.35 and 0.36 – 0.95 in monsoon, winter and summer respectively during 2010-11. The range was narrow in monsoon (0.2 ppm), wide in summer (0.09 ppm) and much wider in winter (0.33 ppm). During 2011-12 the range was 0.75 – 0.98, 0.43 – 0.73 and 0.75 – 1.08 ppm in monsoon, winter and summer respectively. The details of fluctuations are shown in table 10

Table 10 variations in Quantity of Total Nitrogen (PPM) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	1.09	1.11	1.16	1.20	1.19	1.22	1.29	1.21
	**	0.79	0.75	0.86	0.89	0.98	0.92	0.88	0.91
Winter	*	1.02	1.11	1.19	1.20	1.16	1.24	1.35	1.32
	**	0.43	0.48	0.51	0.66	0.69	0.71	0.70	0.73
Summer	*	0.89	0.86	0.88	0.91	0.92	0.93	0.95	9.94
	**	0.75	0.81	0.84	0.92	0.94	1.02	1.08	0.99

SULPHATES: The variations of sulphates contents showed the maximum in summers and minimum in winters of both the years. At station 1 the range of sulphates in monsoon was 1.63 – 1.80 ppm, in winter 0.88 – 1.86 ppm in summer 0.88 ppm to 1.85 ppm during 2010-11. The range was narrow in monsoon (0.17 ppm) wide and almost identical in winter and in summer (0.98 and 0.97 ppm). During 2011-12 the range was 1.84 – 1.89 ppm, 1.52 – 1.88 ppm and 1.71 – 1.95 ppm in monsoon, winter and summer respectively. The range was narrow in monsoon (0.05 ppm), wide in summer (0.25 ppm) and much wider in winter (0.36 ppm). The details of fluctuations of sulphate content are shown in table.

PHOSPHATES: The presence of phosphates in large quantities in fresh water indicates the pollution through seawage or industrial waste. Seasonal analysis of phosphate content showed the maximum during monsoon and minimum during the winter of both the years. The range of phosphate content was 0.16 – 0.20 ppm, 0.03 – 0.09 ppm and 0.08 – 0.16 ppm in monsoon, winter and summer during 2010-11. The range was narrow in monsoon (0.04 ppm) wide in winter (0.06 ppm) and wider in summer (0.08 ppm). During 2011-12 the range was 0.07 – 0.14 ppm, 0.06 – 0.09 and 0.07 – 0.11 ppm in monsoon, winter and summer respectively, showing narrow range in winter (0.03 ppm) wide in summer (0.04 ppm) and wider in monsoon (0.07 ppm). The details of quantities of phosphates recorded during the period of study are shown in table 12.

CHLORIDES:- Chlorides occur in all natural waters in widely varying concentrations, uplands and mountain streams are usually low in chloride concentration. The quantities of chlorides increases during underground formations, seepage, animal excreta, industrial waste etc. The range of concentration of chlorides was 22.80 – 57.40 ppm and 21.61 – 52.48 ppm during the year 2010-11 and 2011-12 respectively. The seasonal variation in chloride content showed the maximum in summer and minimum in winter of both the years. The range in monsoon was 32.81 – 47.46 ppm, in winter 24.06 – 46.30 ppm and in summer 23.48 – 57.56 ppm during the year 2010-11. The range was narrow in monsoon (14.65 ppm), much wide in winter (22.24 ppm) and still

wider in summer (34.08 ppm). During 2011-12 the range was 24.75 – 39.40 ppm, 21.74 – 28.84 ppm and 26.63 – 54.12 ppm in monsoon, winter and summer respectively. The range was narrow in winte r(7.1 ppm) wide in monsoon (14.65 ppm) and much wider in summer (27.49 ppm). The details of the chlorides recorded during the period of study and shown in table 13.

Table 11 : variations in the quantity of sulphates (PPM) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	1.63	1.65	1.69	1.72	1.74	1.78	1.80	1.79
	**	1.88	1.84	1.85	1.86	1.88	1.89	1.87	1.89
Winter	*	0.89	0.88	1.20	1.84	1.79	1.82	1.85	1.86
	**	1.52	1.56	1.61	1.67	1.71	1.74	1.88	1.84
Summer	*	0.98	1.10	0.88	1.20	1.42	1.85	1.75	1.79
	**	1.81	1.70	1.84	1.88	1.93	1.95	1.92	1.91

Table 13 : variations in the quantity of Phosphates (PPM) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	0.16	0.19	0.17	0.18	0.19	0.18	0.20	0.19
	**	0.07	0.09	0.08	0.10	0.11	0.13	0.09	0.14
Winter	*	0.04	0.03	0.06	0.05	0.07	0.08	0.04	0.09
	**	0.06	0.07	0.08	0.06	0.09	0.07	0.09	0.08
Summer	*	0.10	0.08	0.12	0.14	0.15	0.13	0.16	0.11
	**	0.07	0.08	0.09	0.10	0.07	0.08	0.11	0.09

Table 12 : variations in the quantity of chlorides (PPM) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	33.04	32.81	34.64	42.83	47.46	46.89	41.36	44.6
	**	24.75	26.18	30.11	34.73	36.84	37.85	39.40	38.4
Winter	*	46.30	44.91	41.51	38.64	32.61	24.06	26.92	28.6
	**	27.14	28.84	26.18	24.31	23.67	22.19	21.74	22.0
Summer	*	23.48	41.72	40.41	48.73	49.99	51.64	54.18	57.5
	**	26.63	30.81	37.32	39.14	44.63	49.23	54.12	53.9

TOTAL SOLIDS: The annual range of quantities of the total solids recorded was 421.0 – 474 ppm and 425.4 – 470.2 ppm during 2010-11 and 2011-12 respectively . The seasonwise analysis of the total solids showed that it was highest in onsoons and lowest in winters of both the years. During 2010-11the range in monsoon was 458.8 – 473.6 ppm, in winter 421.0 – 439.1 ppm, and in summer 425.0 – 465.6 ppm. The range was narrow in monsoon (14.8 ppm) wide and almost identical in winter (18.1 ppm), much wider in summer (40.6 ppm). During 2011-12 the range was 449.6 – 468.4 ppm, 426.9 – 436.5 ppm and 436.9 – 456.6 ppm in monsoon, winter and summer respectively. The range was narrow in winter (9.6 ppm), wide and identical in monsoon and summer (18.8 ppm and 19.7 ppm).

Table 14 : variations in the quantity of total solids (PPM) during 2010-11 (*) and 2011-12 (**).

Season	Year	Months							
		1		2		3		4	
		I	II	I	II	I	II	I	II
Monsoon	*	458.8	46.3	462.6	473.6	464.3	462.3	470.3	460.2
	**	468.4	461.8	451.8	458.6	450.7	449.6	452.4	459.4
Winter	*	421.0	422.5	423.2	433.4	439.1	437.5	432.2	428.3
	**	426.9	427.3	429.4	433.7	435.6	427.4	436.5	436.5
Summer	*	425.0	429.1	431.7	439.3	444.5	451.6	462.3	465.6
	**	436.9	441.3	446.8	451.8	494.9	456.6	454.1	454.1

ISSN: 0975-8585

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