

Chapter – III

**Observations of Hydrological Studies
on Sewage Abused River Krishna
Near Satara City and LC_{50} Values**

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Krishna Near Satara City and LC_{50} Values

Observation on hydrological studies on the river Krishna near Satara city and LC_{50} value :

Monthly variations in the physico-chemical characteristics such as temperature, transparency, pH, electrical conductivity, dissolved O_2 and CO_2 , hardness, total alkalinity, total dissolved solids and phosphate concentration was studied in the water samples of river Krishna near Satara city to know the hydrological status of the river. Monthly observations for the period of May 2007 to April 2008 were recorded. Samples from four stations namely A (Before sewage dumping), B (Near sewage entry), C about 100 meters away from sewage entry and D (for away from sewage entry were collected in the morning hours 7.00 am to 11.00 am). The above mentioned physico-chemical parameters were analysed in the field and in the laboratory according to standard method of APHA (1998). The results of physico-chemical parameters are tabulated as follows-

- | | |
|--|-------------|
| 1) Temperature and transparency | Table No. 1 |
| 2) pH and electrical conductivity | Table No. 2 |
| 3) Dissolved O_2 and CO_2 | Table No. 3 |
| 4) Hardness and total alkalinity | Table No. 4 |
| 5) Total solids and total dissolved solids | Table No. 5 |
| 6) Concentration of phosphate | Table No. 6 |

Table No. 3.1

Showing monthly variations in the physical parameters temperature and transparency of surface water samples at stations. A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

Months	Temperature in °C				Transparency in cms			
	A	B	C	D	A	B	C	D
May 07	27.00	27.00	21.01	27.00	82	30	70	65
June	20.00	20.00	21.01	20.00	75	25	67	62
July	20.01	20.01	20.02	20.01	77	24	54	53
Aug.	20.02	20.02	20.03	20.03	70	22	68	58
Sept.	21.00	21.00	21.01	21.00	65	25	50	45
Oct.	22.00	22.00	21.00	21.00	65	25	53	45
Nov.	22.17	22.17	22.98	22.19	65	31	50	40
Dec.	23.16	23.17	23.17	23.17	74	30	60	45
Jan. 08	23.00	23.00	23.01	23.00	72	35	60	50
Feb.	24.00	24.00	24.01	24.00	75	38	55	44
March	24.17	24.17	24.18	24.17	78	38	62	50
April	25.18	25.18	25.19	25.19	80	40	60	52

Fig. No. 3.1

Showing monthly variations in the physical parameters temperature of surface water samples at stations. A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

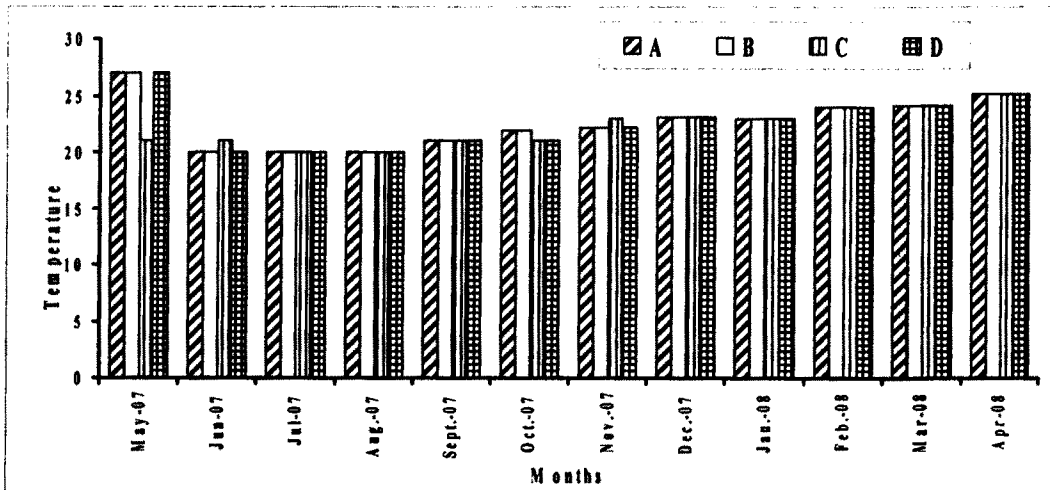


Fig. No. 3.2

Showing monthly variations in the physical parameters transparency of surface water samples at stations. A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

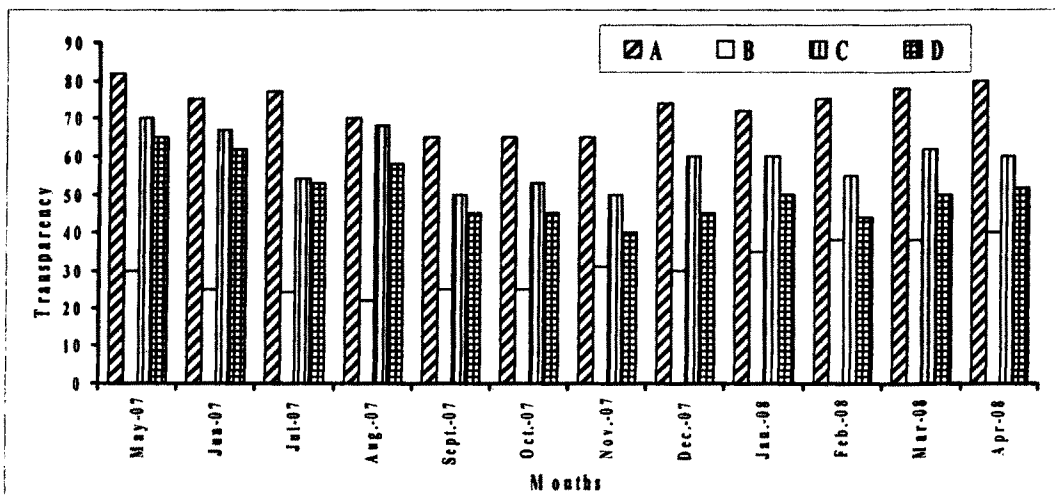


Table No. 3.2

Showing monthly variations in the readings of pH and electrical conductivity of surface water samples at stations. A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

Months	pH				Electrical conductivity $\mu\text{mho/cm}$			
	A	B	C	D	A	B	C	D
May 07	7.50	9.10	8.31	7.62	180	650	280	150
June	7.45	8.03	7.92	7.41	160	630	200	140
July	7.03	7.14	7.79	7.25	162	551	186	130
Aug.	7.04	7.17	7.42	7.18	151	545	176	125
Sept.	7.00	8.40	7.39	7.29	149	525	184	139
Oct.	6.85	8.50	7.88	7.79	151	530	205	162
Nov.	7.20	8.40	7.55	8.08	155	540	190	153
Dec.	7.20	8.03	7.62	7.42	160	550	181	172
Jan. 08	7.30	8.05	7.70	7.49	128	460	175	142
Feb.	7.25	8.03	7.69	7.55	135	590	189	140
March	7.25	8.04	7.04	6.92	161	600	191	172
April	7.50	8.15	7.35	7.40	162	630	201	184

Fig. No. 3.3

Showing monthly variations in the readings of pH of surface water samples at stations. A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

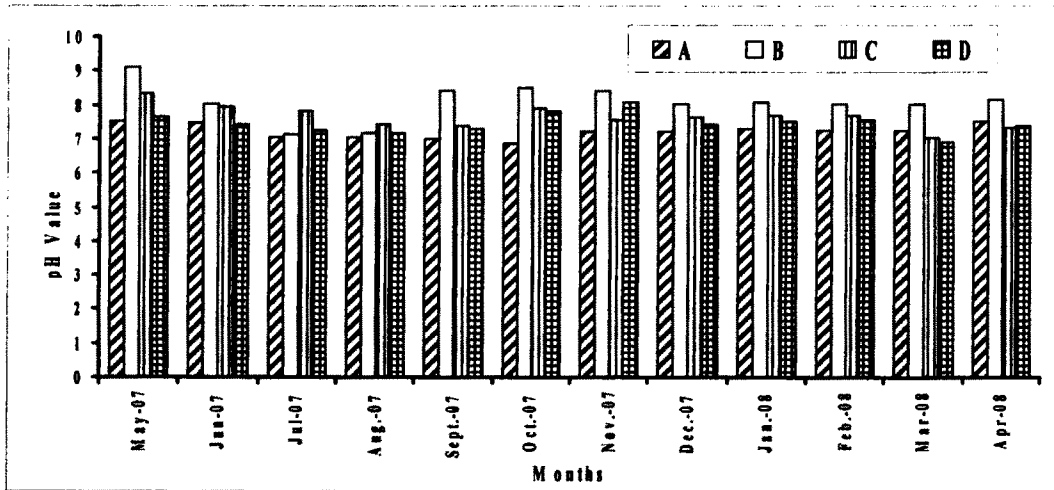


Fig. No. 3.4

Showing monthly variations in the readings of electrical conductivity of surface water samples at stations. A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

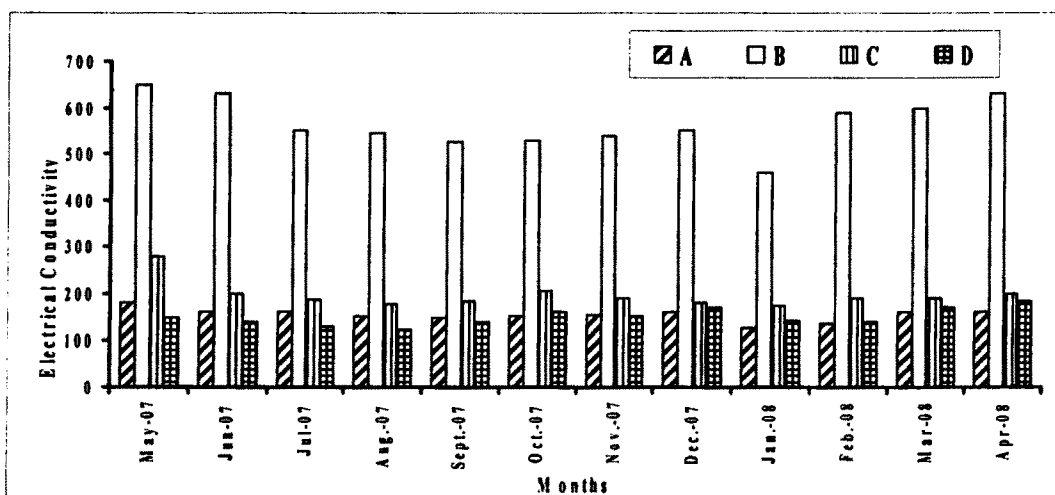


Table No. 3.3

Showing monthly variations in the readings of dissolved O₂ and free CO₂ of surface water samples at stations A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

Months	Dissolved O ₂ mg/lit				Free CO ₂ mg/lit			
	A	B	C	D	A	B	C	D
May 07	7.82	6.12	6.90	7.78	6.30	4.25	6.30	7.98
June	8.92	6.09	6.72	8.12	4.25	3.25	4.25	5.30
July	8.22	6.37	6.90	7.92	5.50	4.50	5.55	6.60
Aug.	9.41	6.80	7.32	8.42	5.62	4.68	5.65	5.75
Sept.	8.52	6.74	7.40	8.48	5.30	4.30	5.35	6.70
Oct.	7.92	6.66	7.09	7.81	2.92	1.20	3.92	2.88
Nov.	7.84	6.30	7.12	7.75	2.17	1.15	2.19	3.30
Dec.	7.92	6.54	6.84	7.88	6.33	5.33	7.33	7.35
Jan. 08	8.12	6.78	7.90	8.01	5.30	4.30	6.30	6.45
Feb.	7.40	6.92	7.80	7.92	5.42	4.25	6.88	6.45
March	7.92	6.88	7.72	7.81	6.40	4.03	7.40	7.32
April	8.04	6.92	7.84	7.98	6.45	4.82	7.31	7.44

Fig. No. 3.5

Showing monthly variations in the readings of dissolved O₂ of surface water samples at stations A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

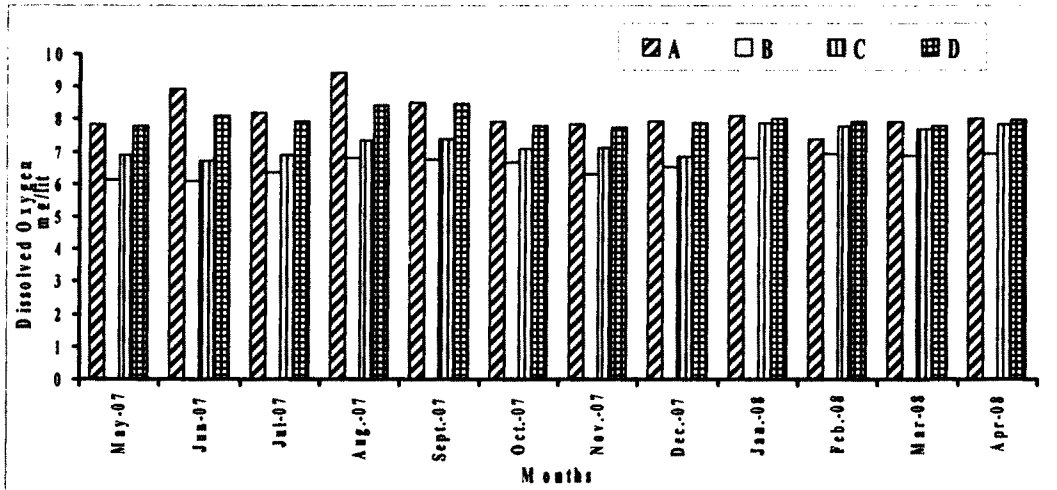


Fig. No. 3.6

Showing monthly variations in the readings of free CO₂ of surface water samples at stations A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

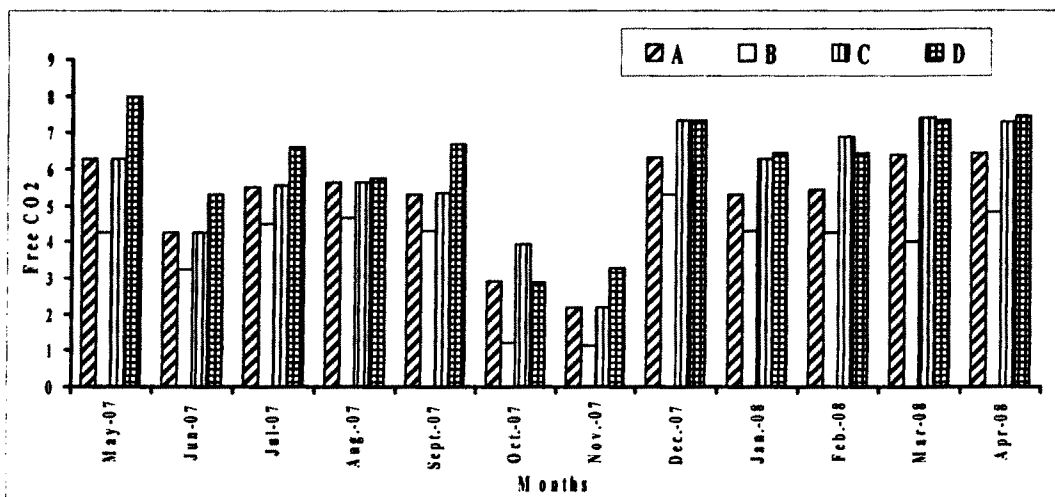


Table No. 3.4

Showing monthly variations in the readings of hardness and total alkalinity of surface water samples at stations A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

Months	Hardness CaCO ₃ mg/lit				Total Alkalinity			
	A	B	C	D	A	B	C	D
May 07	35	38	31	34	62	76	66	60
June	42	48	45	41	72	88	70	69
July	52	56	48	42	70	92	74	72
Aug.	40	44	41	40	79	81	69	75
Sept.	42	49	52	39	68	78	60	71
Oct.	49	55	45	44	69	74	67	68
Nov.	55	62	59	46	78	80	71	73
Dec.	31	41	45	39	82	88	74	75
Jan. 08	38	46	40	44	75	79	70	71
Feb.	44	52	45	49	80	89	79	85
March	32	38	40	36	69	72	68	65
April	48	55	49	45	75	80	72	70

Fig. No. 3.7

Showing monthly variations in the readings of hardness of surface water samples at stations A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

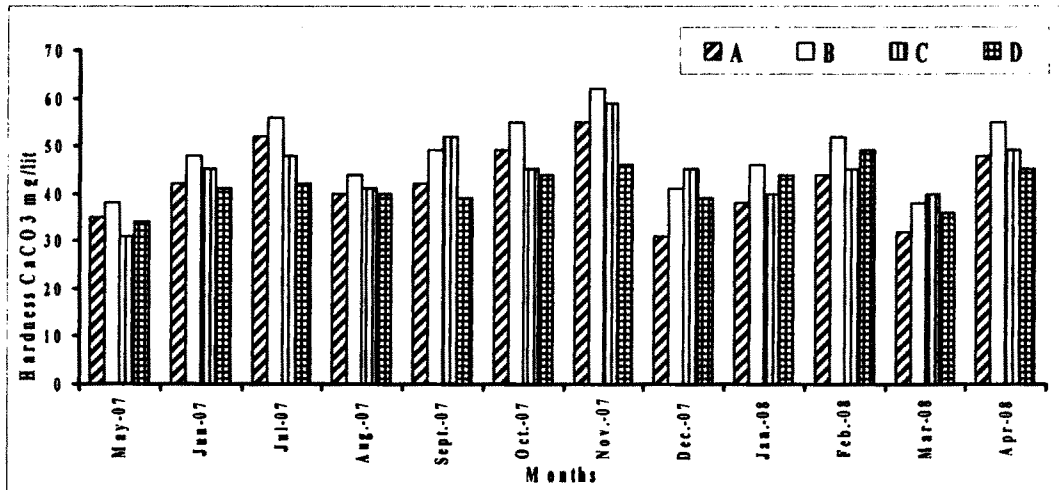


Fig. No. 3.8

Showing monthly variations in the readings of total alkalinity of surface water samples at stations A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

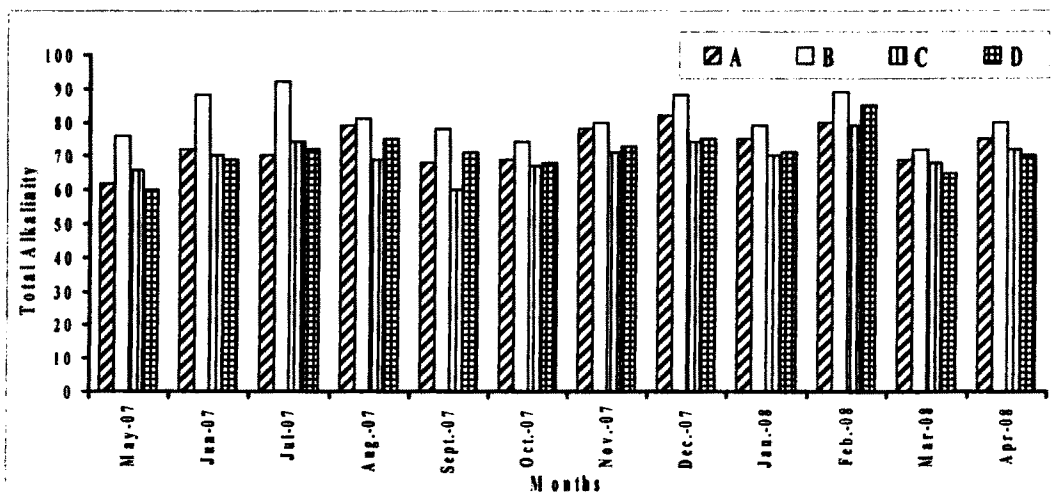


Table No. 3.5

Showing monthly variations in the readings of total solids and total dissolved solids of surface water samples at stations A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

Months	Total Solids				Total dissolved solids			
	TS		mg/lit		TDS		mg/lit	
	A	B	C	D	A	B	C	D
May 07	184	234	201	174	82	102	92	89
June	175	242	212	168	80	115	98	82
July	191	222	194	171	92	100	88	88
Aug.	179	235	182	178	98	119	90	72
Sept.	182	245	189	169	90	124	96	79
Oct.	175	212	192	162	89	112	95	81
Nov.	170	224	172	167	75	109	81	80
Dec.	169	238	175	175	79	108	92	89
Jan. 08	175	220	160	159	82	124	88	79
Feb.	178	241	175	162	76	122	84	85
March	183	232	188	169	74	117	75	70
April	188	231	181	171	70	112	81	76

Fig. No. 3.9

Showing monthly variations in the readings of total solids of surface water samples at stations A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

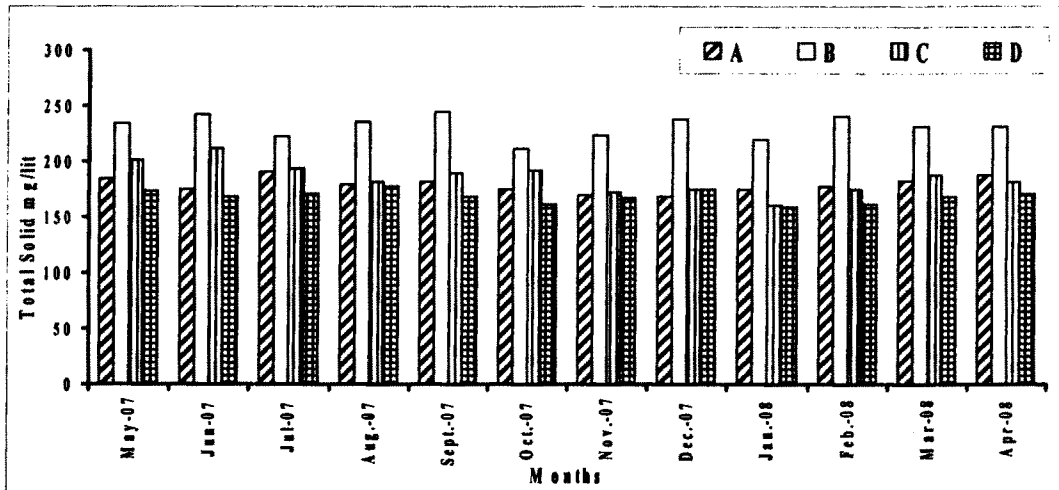


Fig. No. 3.10

Showing monthly variations in the readings of total dissolved solids of surface water samples at stations A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.

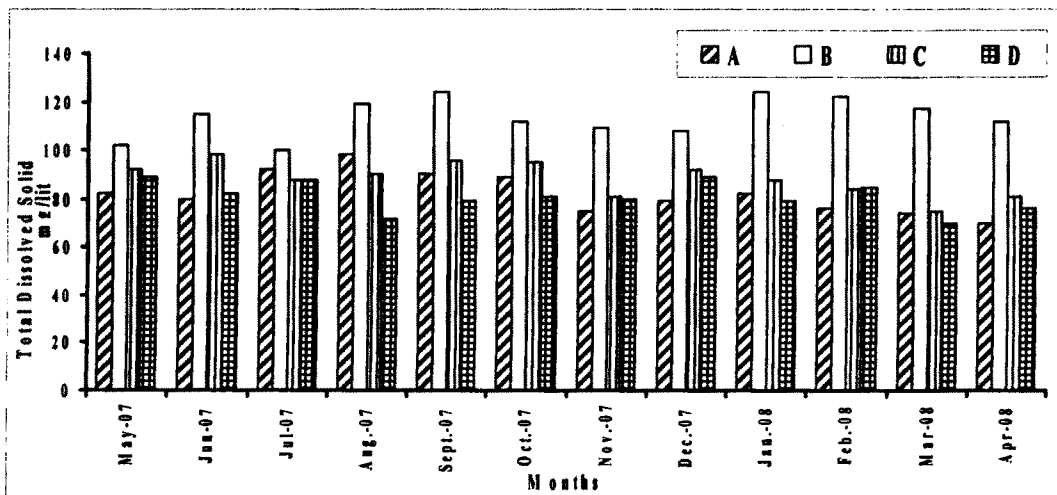


Table No. 3.6

Showing monthly variations in the readings of phosphate in mg/l at stations

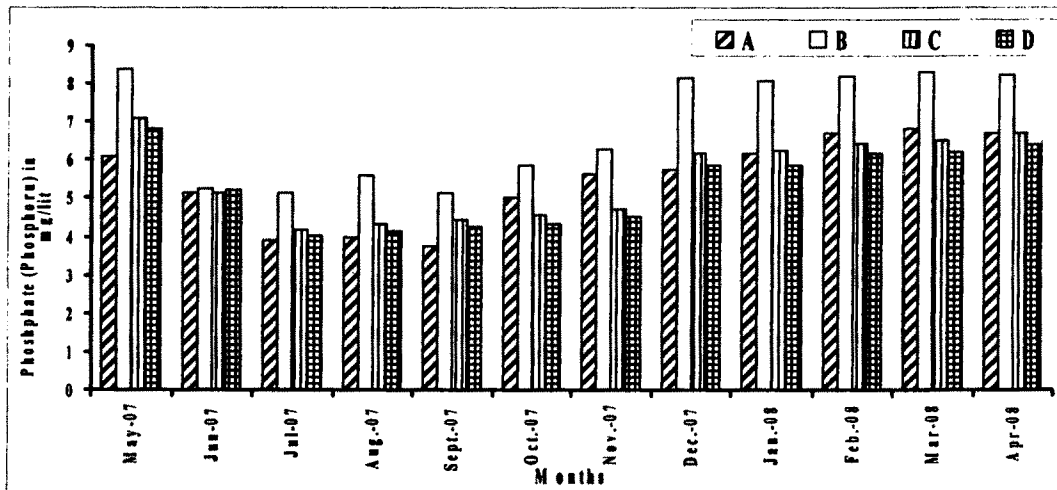
A, B, C and D for the period to May 2007 to April 2008

at river Krishna near Satara city.

Months	Phosphphate (Phosphorus) in mg/lit			
	A	B	C	D
May 07	6.10	8.40	7.10	6.80
June	5.14	5.24	5.15	5.21
July	3.90	5.14	4.16	4.02
Aug.	3.97	5.60	4.32	4.12
Sept.	3.75	5.15	4.46	4.26
Oct.	5.00	5.87	4.56	4.32
Nov.	5.64	6.27	4.70	4.51
Dec.	5.74	8.15	6.15	5.85
Jan. 08	6.15	8.10	6.25	5.85
Feb.	6.70	8.20	6.45	6.15
March	6.82	8.30	6.50	6.20
April	6.70	8.25	6.70	6.40

Fig. No. 3.11

Showing monthly variations in the readings of phosphate in mg/l at stations A, B, C and D for the period to May 2007 to April 2008 at river Krishna near Satara city.



Results and Discussion :

Limnology plays an important role in counteracting with problems of pollution control fish enhancement and aquaculture practices survival of an aquatic organism under toxicant such as physical and chemical parameters of water (Brungs et. al. 1977). From the critical analysis of the literature it seemed that here is limited information on the interaction of physical and chemical parameters and the phosphate concentration in the aquatic animals particularly fish. All these tests are carried out to know the quality water at different stations.

Physical factors :**1) Temperature :**

The observations on temperature in °C in the present investigation in the river Krishna at stations A, B, C and D are recorded in the table No. 1.

Temperature is most likely to affect the responses of the fish to acute concentrations of pesticides. The degree of temperature influence depends on the species and type of toxicant (Holden, 1973). In the present river water temperature showed expected variations in the temperature i.e. highest (27°C) in month of May and lowest (20°C) in the months August and September. The temperature effects on chemical toxicity are complex, because temperature alone may be lethal. Hence evaluating tests are carried out at controlled temperatures i.e. almost constant temperature nearer to the natural environment of the test fish in order to avoid the effects of temperature on phosphate impact. It will be interesting to study phosphate concentration coupled with temperature variations and its impact on fishes.

Transparency :

The transparency in cms in the river Krishna at stations A, B, C and D are recorded in Table No. 1.

The four stations A, B, C and D in the river Krishna studied for river Krishna used that Station B where sewage water is dumped in the river the lowest transparency is observed. Water at station A prior to the dumping site is clear and transparency value is maximum between a range of 82 to 65 cm. Where at B site indicate less transparency between a range 40 to 22 cms. The water progressively become more transparent at C and D sites. The observations on the transparency have been recorded in Table No. 1.

pH :

Observations on the pH values of water in the river Krishna at Stations A, B, C and D are tabulated in Table No. 2. The pH values at Station B increase considerably than rest of the stations (Range 7.14 to 9.1). The pH of the water can affect of some pesticides. But as per Aquatic Life Advisory Committee (1955), pH is a poor criteria for the expression of the toxicity and pH range of 5 to 9 is known to be nontoxic.

Electrical conductivity :

Observations on the electrical conductance of water in the river Krishna at stations A, B, C and D are tabulated in the table No. 2. From the observations it is evident that maximum electrical conductance is observed at station B with a range of 525 to 650 $\mu\text{Mho}/\text{cm}^{-1}$ throughout the year.

From the available data on water conductance no concrete conclusion could be arrived at but along with the other parameters this factor must be studied as there is relationship between transparency and electrical conductance.

Dissolved Oxygen (DO) :

Observations on the DO of water in the river Krishna at stations A, B, C and D are tabulated in table No. 3. In present investigation station B showed lowest range of DO (6.09 mg/l to 6.88 mg/l) and rest of the stations show much higher value of DO.

The dissolved oxygen limits productivity in freshwater (Sriwastava, 1985) and influences the toxicity of pesticides. In extreme depletions of DO level, fish may die of asphyxia. Recording to Aquatic Life Advisory Committee (1955) the dissolved oxygen content shall not be less than 5 ppm during at least 16 hrs. of any 24 hrs. period. The quantity of dissolved oxygen in water is directly or indirectly dependent on water temperature, partial pressure of

oxygen in the air, concentration of dissolved salts, amount of chlorophyll content etc. (Welch, 1952).

Free CO₂ :

Observations on the free CO₂ of water in the river Krishna at stations A, B, C and D are tabulated in Table NO. 3.

In the present investigation station B showed minimum value (range 1.15 mg/l to 5.33 mg/l). Due to the unstable state of free carbondioxide, it escapes as the saturation level is attained. Therefore no correlation with other abiotic or biotic factor could be established. Generally maximum free CO₂ is observed in the early morning than that of the evening (Mann, 1958).

Hardness and Total Alkalinity :

Hardness in the present investigation in terms of mg/l of CaCO₃ of the water of river Krishna at stations A, B, C and D are tabulated in Table No. 4. In the present study, the hardness ranges from 38 mg/l to 62 mg/l at station B in the month of May 2007 and Nov. 2007 respectively. Though there were fluctuations in the hardness from May to July 2007 the pattern of changes was almost similar. Hardness less than 5 mg/l gives slow growth, distress and leads to death (Swingle, 1967). Sreenivasan (1964) also correlated hardness of water with organic productivity. From present study on hardness it is clear that the water is more suitable at stations A, C and D is more suitable for aquaculture practices.

In the present investigation pattern of fluctuations in the total alkalinity showed similar pattern as that of hardness.

Total solids and total dissolved solids :

Total solid and total dissolved solids in the present investigation of the water of river Krishna at station A, B, C and D are tabulated in Table No. 5. The observations indicated higher values of both total solid and total dissolved solids both at higher ranges in water at station B.

A station B total solids range from 212 mg/l to 245 mg/l where as total dissolved solids range from 108 mg/l to 214 mg/l

Phosphate :

Monthly variations for the period May 2007 to April 2008.

The observations on the monthly variations for the period May 2007 to April 2008 in phosphate content in the river Krishna at stations A, B, C and D are recorded and tabulated in Table No. 6. The phosphate content recorded was minimum 5.15 mg/l in the month of September 2007 and maximum 8.40 mg/l in the month of May 2007 at station B, which is highest among all stations. Overall observations at all stations indicted that the phosphate content is much higher i.e. more than 5 mg/l in the river Krishna at Satara city.

The phosphate more than 2 mg/l in open water gives a sign of organic pollution (Pomeroy et al 1965). As a nutrient, excess of phosphate stimulates development of algal blooms of blue green algae like microcystis which are toxic in nature.

From all above hydrological studies it was evident that especially water at station B in the river Krishna near Satara city were sewage is dumped in it is highly pollulated. The other stations A, C and D are comparatively having less pollution. The water from river Krishna thus have detrimental effect on flora and fauna in it especially edible common fishes like Channa striatus. Hence present investigation is significant with respect to effect of phosphate as a pollutant on the important target attain such as stomach, liver, kidney and gills of Channa striatus.

Observations on LC₅₀ value :

Determination of LC₅₀ value for fish (Channa striatus) under investigation was carried out by using different concentrations of phosphate. The results of the rate of mortality are shown in Table No. ____ and graphically

The results indicate 50% mortality at 72 hrs. at 0.125 M phosphate concentration. Therefore the LC50 value for Channa striatus is 0.0125 M for phosphate.

Table No. 3.7

Showing Mortality record of Channa striatus at different concentrations of phosphate.

Concentration of phosphate Control	No. of fishes used	No. of dead fishes				Mortality at 72 hrs.
		24 hrs	48 hrs	72 hrs	96 hrs	
0.005	10	Nil	Nil	Nil	Nil	0.0%
0.006	10	Nil	Nil	Nil	Nil	0.0%
0.007	10	Nil	Nil	Nil	Nil	0.0%
0.01	10	Nil	2	2	3	40%
0.015	10	Nil	3	3	4	60%
0.02	10	2	4	4	-	100

Fig. No. 3.12

Showing Mortality record of Channa striatus at different concentrations of phosphate.

