Nature Environment and Pollution Technology © Technoscience Publications	Vol. 7	No. 2	pp. 319-325	2008

PRELIMINARY STUDY ON SELECTED PARAMETERS OF TUMKUR CITY SEWAGE

K. S. Kumara and S. L. Belagali
Department of Studies in Environmental Science, University of Mysore, Mysore-570 006, Karnataka

ABSTRACT

Sewage is domestic waste enriched with nutrients and plays vital role in water pollution. Tumkur city sewage studies were conducted during summer and monsoon (Feb. 2007 to Sept. 2007) for temperature, pH, EC, total dissolved solids (TDS), dissolved oxygen (DO), free carbon dioxide, hydrogen sulphide, BOD, COD, acidity, alkalinity, hardness, chloride, nitrate and phosphate from six sampling points namely residential area (S_1), business centre (S_2), slum (S_3), converging point (S_4), open drain (S_5) and treated (S_6). The results revealed that the EC, chloride, hardness, TDS, alkalinity and acidity were decreased, whereas pH and DO values increased in the treated sewage. The significance of closed, open drainage, converging and treated sewage chemistry results are discussed in light of the recent literature. The low cost treatment measures are suggested to reduce BOD and nutrient levels of the sewage.

INTRODUCTION

Determination of sewage characteristics is useful in identifying the appropriate methodology for treatment and to design the facility for disposal and reuse (Tchobanoglous 1979). The anthropogenic activity becomes prime concern for production and discharge of sewage into the wetlands, which ultimately is a major concern for the welfare of human beings (Thirumurty & Francis Fanthome 1995). The raw sewage consists of 99.9% water and 0.1% solids which include 70% organic and 30% inorganic materials. The organic materials include 65% proteins, 25% carbohydrates and 10% fats and the inorganic materials include grit, salts, metals, etc. (Sharma & Kaur 1994). The sewage is nutrient source for maintaining biological richness of a water body. The sewage when influxes the aquatic systems cause serious effects on physico-chemical and biological characteristics of the waters. The oxygen present in the lotic/lentic systems would destroy the organic part of sewage under natural processes. The biodegradable substances of sewage are rapidly decomposed by oxidation. The population explosion among developing countries and the sustainable consumption pattern are escalating stress on aquatic environmental systems by sewage. The production and unscientific discharge of sewage generates toxic materials and also creates serious problems to environment and biodiversity (Dara 2006). The strength of sewage varies in different geographical locations owing to the differences in diet, and water consumption of animals and human beings. Due to accumulation of domestic waste or sewage in aquatic bodies, they are unable to recycle them and their self regulating capacity decreases. When the aquatic systems are enriched with nutrients of sewage, they cause eutrophication which results in the loss of hydrobionts (Ninave 2000). During this process oxygen requirement (BOD) increases. The sewage supports the growth of fast growing aquatic weeds but affects the growth of waterborne organisms (Bazzaz 1990). It is found that, a large amount of domestic sewage generated in the Indian cities is confluenced with inland waters and sea. Hence, an attempt has been made for the preliminary study of some selected parameters during summer and monsoon (Feb. 2007 to Sept. 2007) of Tumkur city sewage in Karnataka State, India.

MATERIALS AND METHODS

The Tumkur city is located between 13°19'0" to 13°27'19" north latitude and 77°05'26" to 77°07'12" east longitude, about 68 km in the north west of Bangalore. It lies at 818.51 m above MSL and has spread in an area of about 102.6 sq. km with the population of about 3 lakh. The rain is confined to the months of May and November with an average rainfall of about 586.2 mm, the temperature raises from March to May. South west monsoon starts in June and thereafter the temperature decreases. The average ambient temperature during the observation period was 28°C.

The sewage samples were collected separately in 3-litre polythene cans from six sampling points S_1, S_2, S_3 (closed), S_4 (converging), S_5 (open) and S_6 (treated) between 7 A.M. to 8 A.M. in first week of every month, and immediately brought to the laboratory for analysis. The temperature, pH, EC, TDS, DO, CO_2, H_2S, BOD, COD, acidity, alkalinity, hardness, chloride, nitrate and phosphate were estimated following the standard methods (APHA, AWWA, WEF 1995).

RESULTS AND DISCUSSION

Several factors are to be considered while assessing the quality of sewage which includes physical, chemical and biological characteristics. The values of temperature are given in Table 1 and Fig. 1. pH is hydrogen ion activity and varies due to the microbial activities (Garg et al. 2007). The pH varied between 7.3 and 8.1 (Table 2, Fig. 2). The pH values are higher in open drain (S_5) and treated sample (S_6).

EC of treated sample (S_6) is low (1.343 mS/cm) and high for residential area (S_1) at 2.01mS/cm (Table 3, Fig. 3). EC is used to evaluate variations in dissolved salts of wastewaters. The high electrical conductivity value of S_1 sample is due to the presence of high concentrations of ionic constituents.

The TDS values are in accordance with EC values with little variations (Table 4, Fig. 4). Analysis of solids is important in the control of biological and physical wastewater treatment processes (APHA AWWA WEF 1995). Since the TDS values are low in the above samples, they do not affect the treatment process.

Dissolved oxygen varies from 1.91 mg/L to 3.60 mg/L (Table 5, Fig. 5). The low values of DO are due to low photosynthetic activity and more consumption by biota (Wetzel 1983). The lower DO values indicate the presence of high organic pollutants. However, there is a considerable increase in the DO value after aeration treatment.

The free carbon dioxide is the only source of carbon assimilated and incorporated into the body of living aquatic autotrophs (Shoukat Ara et al. 2003). The CO_2 concentration was found constantly higher in all the samples except the treated sample (Table 6, Fig. 6) due to the high microbial activity.

Hydrogen sulphide content was found to be higher during summer season and minimum in rainy season (Table 7, Fig. 7).

The maximum BOD (435mg/L) was recorded in S_4 and minimum (154mg/L) at S_6 (Table 8, Fig. 8). BOD values for all the untreated samples were in higher range and show the maximum organic pollution. The sample station S_4 is receiving the wastes from slaughter houses. The BOD value is reduced almost 50% after the aeration treatment.

The maximum COD was 745mg/L recorded in S_3, and minimum of 78mg/L recorded in S_6 (Table 9, Fig. 9), which indicates that the raw sewage has high COD values because of more presence of oxidisable organic matter (Maya et al. 2007).

Acidity of sewage was found to be high in raw sewage samples (S_1, S_2, S_3, S_4 and S_5) and low in treated sample S_6 (Table 10, Fig. 10). Alkalinity is significantly reduced in the treated wastewater. The raw sewage alkalinity ranged from 971mg/L to 1339mg/L, which has reduced to 665mg/L in treated sample (S_6) (Table 11, Fig. 11).

Hardness of sewage is mainly due to calcium and magnesium salts, which are consistent in all the samples. The higher values were recorded in the raw sewage samples than the treated one. The values ranged between 360 mg/L and 600 mg/L (Table 12, Fig. 12). Chloride values varied from 84 mg/L to 383 mg/L (Table 13, Fig. 13) and found low in the month of May for S_5 sample owing to the dilution effect. High chloride value may be due to organic wastes of animal origin and domestic wastes.

Nitrate-N in the present study varied from 0.05 mg/L to 0.26mg/L (Table14, Fig. 14). Nitrogen is essential for all organisms for basic processes of life. Nitrate concentration is consistent in all untreated samples which encourages the eutrophication. Direct relation exists between the degree of pollution and concentration of nitrates. Low concentration of nitrate during June, July, August and September may be due to utilization by algae as they highly consume nitrates. Microbial activity can also be responsible for low value (Sharma et al. 1981).

Inorganic phosphorus in the form of orthophosphate plays a dynamic role in aquatic ecosystems, as it is readily taken up by phytoplankton or lost to the sediment. The values are high during July 2007 (Table15, Fig. 15). The increase in value is due to land runoff, decayed phytoplankton and

Table 1: Variation in temperature (°C).

Month	S1	S2	S3	S4	S5	S6
Feb-07	29	29	29	29	29	29
Mar-07	31	31	31	31	31	31
Apr-07	32	32	32	32	32	32
May-07	32	32	32	32	32	32
Jun-07	34	34	34	34	34	34
Jul-07	27	27	27	27	27	27
Aug-07	25	25	25	25	25	25
Sep-07	27	27	27	27	27	27

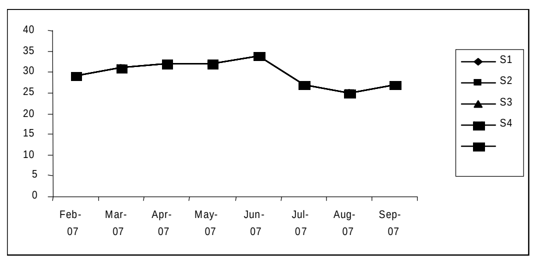

Fig. 1: Variation in Temperature (°C)

Table 2: Variations in pH.

Month	S1	S2	S3	S4	S5	S6
Feb-07	7.37	7.36	7.38	7.87	7.37	7.9
Mar-07	7.75	8.16	7.16	7.79	7.74	8.1
Apr-07	7.33	7.31	7.27	7.22	7.77	7.9
May-07	7.16	7.2	7.13	6.83	7.46	7.97
Jun-07	7.7	7.92	7.65	7.59	7.96	8.82
Jul-07	7.16	7.28	7.3	7.11	7.65	8.39
Aug-07	7.7	7.5	7.6	7.4	7.8	7.7
Sep-07	7.2	7.1	7.3	7.8	7.5	7.7

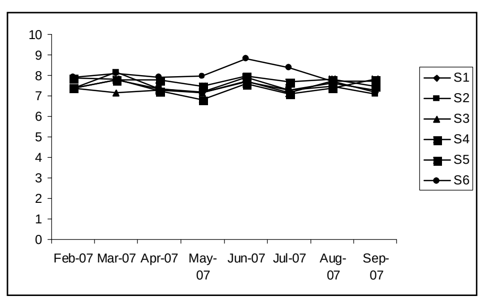

Fig. 2: Variations in pH.

Table 3:Variations in EC ($mScm^{-1}$).

Month	S1	S2	S3	S4	S5	S6
Feb-07	2.04	1.86	1.95	2.04	1.67	1.45
Mar-07	2.3	2	2.1	2.2	1.9	1.4
Apr-07	1.95	1.51	1.95	1.78	1.51	1.35
May-07	1.7	1.6	1.04	1.5	0.7	1.4
Jun-07	2.1	1.7	1.7	1.9	1.8	1.3
Jul-07	2.1	1.7	1.8	2	1.8	1.3
Aug-07	1.9	1.6	1.7	2	1.7	1.2
Sep-07	2	1.6	1.3	1.7	1.7	1.01

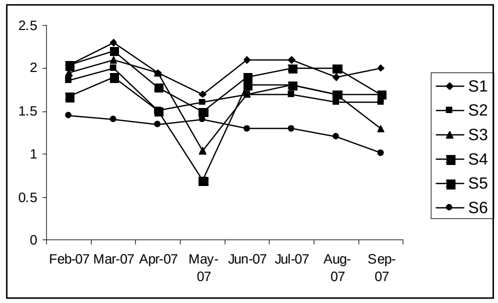

Fig. 3: Variations in EC ($mScm^{-1}$).

Table 4: Variations in TDS (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	830	850	840	845	849	610
Mar-07	960	1330	1330	1010	946	630
Apr-07	860	885	845	854	820	640
May-07	620	635	630	640	610	590
Jun-07	920	890	870	960	880	675
Jul-07	1008	844	862	988	866	665
Aug-07	1012	832	852	978	854	650
Sep-07	989	825	860	846	845	620

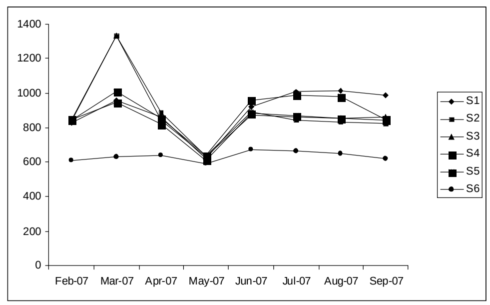

Fig. 4: Variations in TDS (mg/L).

Table 5: Variations in DO (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	1.4	1.8	0	4.4	3.2	3.8
Mar-07	2.8	3.2	5.9	3.2	4.4	3.6
Apr-07	5.5	2.2	3.8	1.8	2.2	4
May-07	3.1	1.8	2.1	2.2	1.1	4.2
Jun-07	0.5	2.6	2.2	1.4	0.9	3.4
Jul-07	0.1	1.2	2.3	0.1	0.3	3.9
Aug-07	0.6	1.1	2.9	1	1.5	3.2
Sep-07	1.4	2.3	1.6	1.8	1.7	2.7

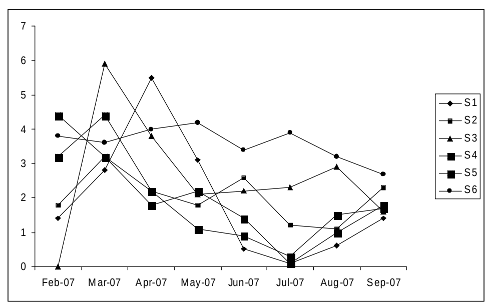

Fig. 5: Variations in DO (mg/L).

Table 6: Variations in free CO_2 (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	42	62	46	42	62	11
Mar-07	56	75	50	36	49	16
Apr-07	62	82	39	38	56	15
May-07	59	94	16	81	62	0
Jun-07	124	51	62	124	113	0
Jul-07	181	53	88	148	139	14
Aug-07	55	90	50	78	57	0
Sep-07	64	36	83	62	88	15

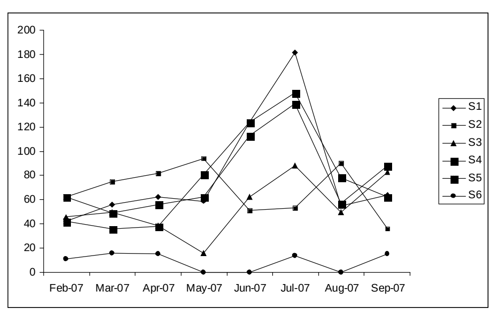

Fig. 6: Variations in free CO_2 (mg/L).

Table 7: Variations in H_2S (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	3.4	1.2	0.42	0.85	0	0
Mar-07	0.85	2.3	0.42	3.82	0	1.2
Apr-07	3.34	1.86	0.5	0.48	0	0
May-07	1.7	0	0	0	0	0
Jun-07	0.21	0.42	1.27	0	0.85	0
Jul-07	0	0.23	1.16	0	0	0.23
Aug-07	0.21	0.23	0.42	0	0	0
Sep-07	0.23	0.46	0	0	0	0.23

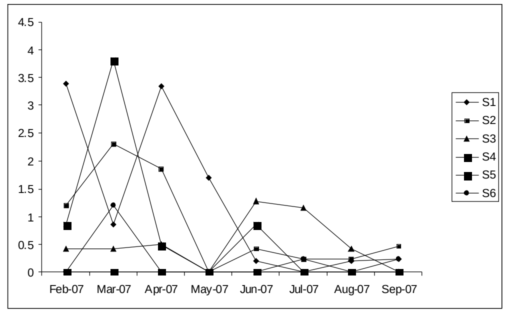

Fig. 7: Variations in H_2S (mg/L).

Table 8: Variations in BOD (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	102	306	428	428	389	110
Mar-07	360	550	816	356	725	135
Apr-07	164	216	633	121	526	160
May-07	220	211	264	97	97	123
Jun-07	570	560	580	550	620	280
Jul-07	100	156	111	201	223	33
Aug-07	240	340	320	330	320	201
Sep-07	381	371	331	347	401	190

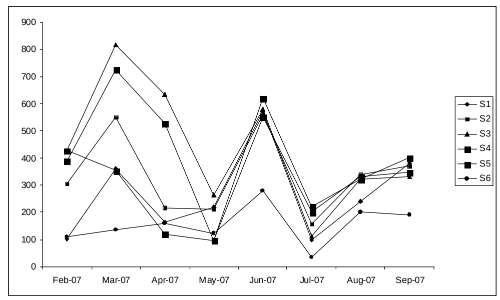

Fig. 8: Variations in BOD (mg/L).

Table 9: Variations in COD (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	760	750	820	770	590	89
Mar-07	780	720	740	820	580	90
Apr-07	740	780	700	810	550	92
May-07	710	760	620	680	510	84
Jun-07	680	710	610	710	520	76
Jul-07	690	730	640	740	530	58
Aug-07	720	720	620	710	560	62
Sep-07	738	740	630	720	540	74

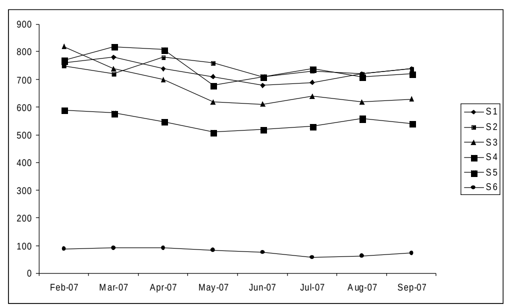

Fig. 9: Variations in COD (mg/L).

Table 10: Variations in acidity (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	322	250	301	258	250	19
Mar-07	522	598	330	475	350	16
Apr-07	161	230	316	194	224	21
May-07	215	145	110	91	39	33
Jun-07	78	52	172	153	103	0
Jul-07	206	61	168	158	100	16
Aug-07	263	171	135	110	72	41
Sep-07	405	202	287	263	206	59

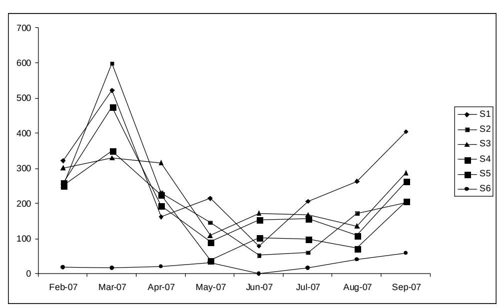

Fig. 10: Variations in Acidity (mg/L).

Table 11: Variations in alkalinity (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	1397	1129	1295	1129	1397	620
Mar-07	1409	1143	1364	1178	1356	690
Apr-07	1551	1116	1329	1170	1444	680
May-07	1211	1008	1054	490	342	703
Jun-07	1433	971	1202	1110	1110	647
Jul-07	1376	1087	1362	1214	1285	748
Aug-07	994	782	860	430	303	549
Sep-07	1339	1050	1184	1050	1036	683

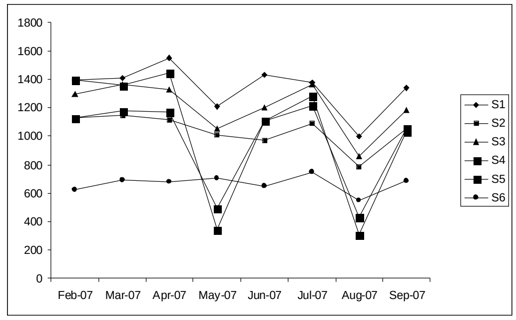

Fig. 11: Variations in alkalinity (mg/L).

Table 12: Variations in hardness (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	466	418	432	428	592	360
Mar-07	490	452	444	454	600	380
Apr-07	504	418	418	394	572	410
May-07	522	496	522	512	464	452
Jun-07	436	412	386	362	472	338
Jul-07	420	390	374	348	488	342
Aug-07	448	464	482	432	438	418
Sep-07	446	484	414	440	446	366

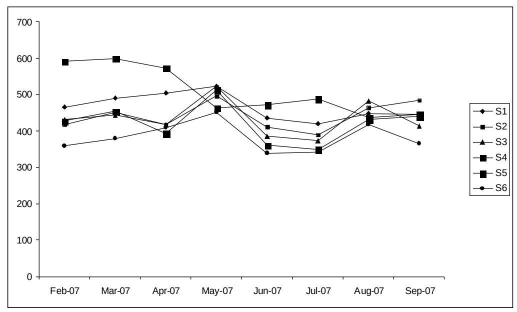

Fig. 12: Variations in hardness (mg/L).

Table 13: Variations in chloride (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	383	281	279	259	335	260
Mar-07	360	320	323	299	344	249
Apr-07	382	325	285	278	330	275
May-07	293	251	238	144	84	297
Jun-07	312	290	327	276	316	251
Jul-07	323	362	316	275	312	262
Aug-07	332	346	352	364	262	246
Sep-07	325	356	324	303	247	256

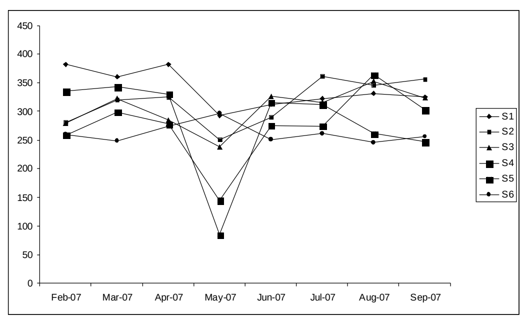

Fig. 13: Variations in chloride (mg/L).

Table 14: Variations in nitrate (mg/L).

Month	S1	S2	S3	S4	S5	S6
Feb-07	0.26	0.16	0.28	0.24	0.26	0.05
Mar-07	0.31	0.38	0.36	0.30	0.26	0.03
Apr-07	0.16	0.08	0.20	0.18	0.06	0.09
May-07	0.40	0.49	0.42	0.46	0.30	0.06
Jun-07	0.06	0.08	0.10	0.08	0.04	0.02
Jul-07	0.08	0.10	0.22	0.30	0.26	0.06
Aug-07	0.18	0.20	0.22	0.28	0.16	0.08
Sep-07	0.20	0.18	0.22	0.20	0.16	0.04

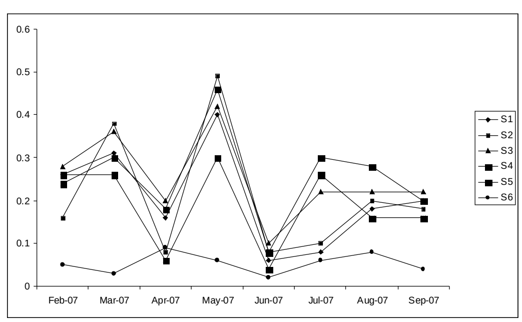

Fig. 14: Variations in nitrate (mg/L).

Table 15: Variations in phosphate.

Month	S1	S2	S3	S4	S5	S6
Feb-07	0.46	0.52	0.70	0.65	0.48	0.55
Mar-07	0.59	0.67	0.70	0.66	0.48	0.64
Apr-07	1.20	1.36	1.40	1.30	1.26	0.66
May-07	1.80	1.70	1.90	1.75	1.66	0.96
Jun-07	2.20	1.12	2.41	1.98	2.12	0.86
Jul-07	2.80	2.40	2.70	2.00	2.60	1.10
Aug-07	0.56	0.76	1.10	1.01	0.68	0.46
Sep-07	1.40	1.46	1.52	1.30	1.10	0.76

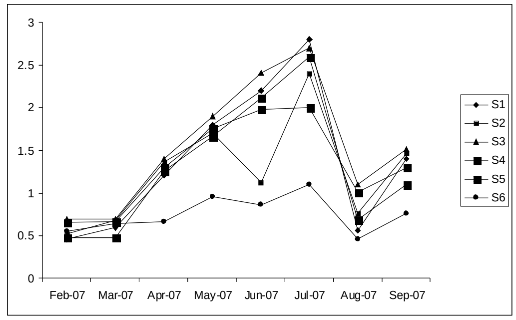

Fig. 15: Variations in phosphate.

concentration of zooplankton wastes (Heron 1961). Use of detergents with long chain phosphate groups has also resulted in excessive phosphorus loading.

With these results, it is observed that Tumkur city sewage physico-chemical characteristics are not significantly higher. So the aeration treatment process is sufficient to reduce the BOD and nutrient level.

ACKNOWLEDGEMENT

The authors are grateful to Management of Sri Siddhartha First Grade College, Tumkur and Prof. H. N. Vjayendra, Principal for their encouragement. First author is also thankful to Dr. M. B. Nadoni, Prof. C.Vijayabhaskar and Prof. M. S. Jayaprakash for their valuable suggestions, and also grateful to Dr. M. K.Veeraiah, Prof. B. Manjunath and Prof. B. Mallesh of S.S.I.T, Tumkur for providing laboratory facilities.

REFERENCES

APHA AWWA WEF 1995. Standard Methods for Examination of Water and Wastewater, 19th edition. American Public Health Association, Washington DC.

Bazzaz, F. A. 1990. The response of natural ecosystem to the rising global CO_2 levels. Annual Review of Ecology and Systematics, 21: 167-196.

Dara, S.S. 2006. A Text Book of Environmental Chemistry and Pollution Control. S. Chand and Co. Publication, New Delhi.

Garg, Deepshika , Singh, R.V and Sunitha Goel, 2007. Studies on the status of drinking water quality in Bharathpur area in Rajasthan. Ind. J. Environ. & Ecoplan., 14(1-2): 131-138.

Heron, J. 1961. Phosphorus adsorption by lake sediments. Limnology and Oceanography, 6: 338.

Maya, C., Raviprasad, G., Krishnaram, H. and Lakshman, M., 2007. Limnological studies on Yellamallappa Chetty lake Banglore. Ind. J. Environ & Ecoplan., 14 (1-2): 115-118.

Ninave, A.S. 2000. Effect of pollution on inland and costal ecosystems and their impact on fishery resources. Ind. J. Environ. & Ecoplan., 3(2): 197-207.

Sharma, B.K. and Kaur, H. 1998. Water Pollution. Goel Publishing House, Meerut, India.

Sharma, R. D., Neeru Lal and Pathak P.D. 1981. Water quality of sewage drains entering Yamuna at Agra. Ind. J. Environ. Health, 23: 118-122.

Shoukat Ara et al. 2003. Physico-chemical characteristics of Dal lake water of Kashmir valley, India. Ind. J. Environ. & Ecoplan., 7(1): 47-50.

Tchobanoghous, 1979. Wastewater Engineering Treatment, Disposal and Reuse (2nd edition), Metcalf-Eddy, Inc., Tata McGraw Hill Pub.Co., New Delhi.

Thirumurty and Fracis Fanthome 1995. Environment under threat. Frank Brothers and Co. Ltd. Publication, Noida (U.P).

Wetzel, R.G. 1993. Limnology, 2nd edition. Saunders College Publishing, USA. pp. 767.