Journal of Environmental Biology **October 2006,** 27(4) 709-712 (2006)

Suitability and water quality criteria of an open drainage municipal sewage water at Coimbatore, used for irrigation

S. Binu Kumari[2], A. Kavitha Kirubavathy[2] and Rajammal Thirumalnesan[1]
[1]Department of Zoology, Avinashilingam Deemed University, Coimbatore – 641 043, India
[2]Department of Zoology, Chikkanna Government Arts College, Tirupur – 641 602, India

(Received: 5 November, 2004 ; Accepted: 11 July, 2005)

Abstract: *Sanganur canal is the major open drainage system which has intricate linkage with storm water supply, domestic sewage and industrial effluent disposal. Water samples from various stations were collected and analysed for physicochemical parameters to assess the water quality of the Sanganur canal system. The study revealed that physicochemical parameters like pH, EC, TDS, DO, BOD, COD exceeded the permissible limit, clearly indicating the need of proper treatment of waste water before discharge into the Noyyal river.*

Key words: *Sanganur canal, Physicochemical analysis, Open drainage.*

Introduction

The Sanganur canal originates from the Western ghats from Kuridimalai hills, flows from west to east, enters Coimbatore city limit at Coimbatore – Mettupalayam road and flows for about 10km within the city outfalling into Singanallur tank. Singanallur tank also has its own supply line from Noyyal river. The tank surpasses into Noyyal river. The sewage discharged from residences which are not provided with septic tanks and sewage disposal arrangements and from unsewered slums and residential colonies constitute a major source of pollution of Sanganur canal. The industrial effluents in parts of Coimbatore south and north were partly discharged into open drain, in unsewered areas which finally join Sanganur canal. As Sanganur canal water at Vellalore is utilized for irrigation, the present study was undertaken to determine the water quality of the Sanganur canal water to assess the suitability of this waste water for irrigation.

Materials and Methods

Water samples were collected from seven sampling locations as shown in Fig. 1. Station 1 is the Asoke Nagar which receives domestic sewage. Station 2 is Rathnapuri which receives domestic sewage and effluents from flour mill industries. Station 3 is Raju Gardens, which receives only domestic sewage. Station 4, Bharathipuram receives effluents form textile mills, electroplating industries, motor and engineering industries, dyeing industries, sugarcane crushers, sheet bending machine industries, monoblock, jet pump and pumpsets. Station 5 is Ramaswamy Naidu layout, where water receives higher amount of effluents from dye testing laboratory, soap company, motor pump engineering unit, transformer unit and electroplating works. Station 6 is Erimedu, here waste water from hospitals, rubber industry, foundry and pumpset industries are let out. Station 7 is Vellalore which receives mixedup domestic sewage from all over the city and effluent from hospitals and all types of industries.

The samples collected from these sampling stations were analysed by following the standard methods of APHA (1992) and Manivasakam (1987).

Results and Discussion

The results of the various physicochemical analyses are presented in Table 1. Temperature of the Sanganur canal water at different stations ranged between 29ºC and 31ºC. Higher temperature could be due to discharge of domestic sewage and industrial effluent into the open drainage. Domestic sewage (S_1, S_2 and S_3) showed alkaline pH (8.17, 11.47 and 7.41), while industrial effluent at S_4 was acidic (6.84), whereas, the places S_5, S_6 and S_7, showed alkaline pH (7.39, 9.30 and 7.74). This may be due to high buffering capacity of the water. Electrical conductivity ranged between 1.39 mmhos/cm to 3.84 mmhos/cm at different sampling stations, while S_2 recorded the maximum of 3.84 mmhos/cm followed by S_5, S_7, S_1, S_3, S_6 and S_4 recording (3.77, 3.39, 3.20, 3.08, 3.00, 3.00 and 1.39 respectively) which may be due to the high concentration of ionic constitutions and heavy sewage dumping (Bhuvaneswaran *et al.,* 1999). At S_2 station (Rathnapuri) domestic and flour mill effluents are discharged, they contain more of organic materials and high concentrations of ionic constituents. Such effluents contributed to the high level EC of 3.84 mmhos/cm. The lowest EC of 1.39 mmhos/cm was recorded at S_4 (Bharathipuram) of industrial area receiving effluent from textile mill, auto carriage, electroplating and motor industry. It was found that those water which receives domestic sewage, sugar factory effluent and paper mill effluent showed a high degree of EC than water which receives industrial effluent as recorded by Sreenivasan and Sounderaraj (1967) and Trivedy (1988).

The maximum value of total solids was at S_6 (14,000mgl^{-1}) followed by S_5 (12,000mgl^{-1}), S_3 (8000mgl^{-1}), S_7 (8000 mgl^{-1}) S_2 (7333.33mgl^{-1}), S_1 (4666.67mgl^{-1}) and S_4 (3333.33mgl^{-1}), which may be due to their flowing nature of the waste water. Similarly Total dissolved solids was maximum at S_6

Table – 1: Physico – chemical characteristic of municipal sewage water of Sanganur canal at different sampling stations

Parameters	S_1	S_2	S_3	S_4	S_5	S_6	S_7	Tolenerance limit ISI 1981	Permissible limit ISI 1982 - Irrigation
1. Temp. °C	29.40	29.45	29.48	30.00	30.16	30.00	31.00	Less than 40°C	-
2. pH	8.17	11.47	7.41	6.84	7.39	9.30	7.74	5.50-9.00	6.00-8.00
3. EC	3.20	3.84	3.08	1.39	3.77	3.00	3.39	-	2.30
4. TS	4666.67±942.81	7333.33±942.81	8000.00±1632.99	3333.33±942.81	12000.00±1632.99	14000.00±1632.99	8000.00±1632.99	-	-
5. TDS	2666.67±942.81	1333.33±942.81	1333.33±942.81	2000.00±0	10666.66±1885.62	12000.00±1885.62	5333.33±941.81	2100.00	2100.00
6. Free CO_2	22.00±0	Bdl	44.00±0	44.00±0	44.00±0	Bdl	51.33±10.37	-	-
7. Total alkalinity	166.67±23.57	400.00±0	100.00±0	133.33±47.14	200.00±0	200.00±0	483.33±23.57	-	-
8. Total hardness	533.33±9.43	46.66±9.43	86.66±9.43	80.00±0	93.33±9.43	60.00±16.33	330.00±14.14	-	-
9. DO	4.41±0.13	4.22±0.23	3.38±0.23	7.81±0.37	6.09±0.35	3.57±0.26	4.31±0.13	-	-
10. BOD	66.67±4.71	347.10±92.87	347.07±47.84	384.67±86.99	365.87±45.93	234.57±57.82	123.33±4.71	30.00	-
11. COD	328.00±6.53	272.00±13.06	186.67±19.96	746.67±19.96	266.67±19.96	1800.00±32.66	277.33±15.08	250.00	500.00
12. Calcium	5.35±1.89	0.016±0	21.38±3.78	18.70±3.78	24.05±6.55	16.03±0	112.22±3.28	-	-
13. Chloride	428.37±12.07	260.33±26.78	291.10±5.80	324.23±24.14	78.10±0	468.60±17.39	227.17±6.69	1000.00	1000.00
14. Sulphate	80.00±0	5.00±0	5.00±0	5.00±0	5.00±0	10.00±0	40.00±0	1000.00	-
15. Phosphate	4.20±0.08	4.87±0.87	5.20±0.70	32.67±0.66	6.40±2.08	6.93±1.18	9.47±0.17	-	-
16. Nitrite	5.95±0	7.94±0	7.94±0	9.26±0.93	7.94±0	5.95±0	19.84±0	-	-
17. Amm. nitro	56.03±0	61.63±0	22.41±0	28.01±0	33.62±0	22.41±0	33.62±0	50.00	-

All values are in mgl^{-1} except pH and EC (mmhos/cm)

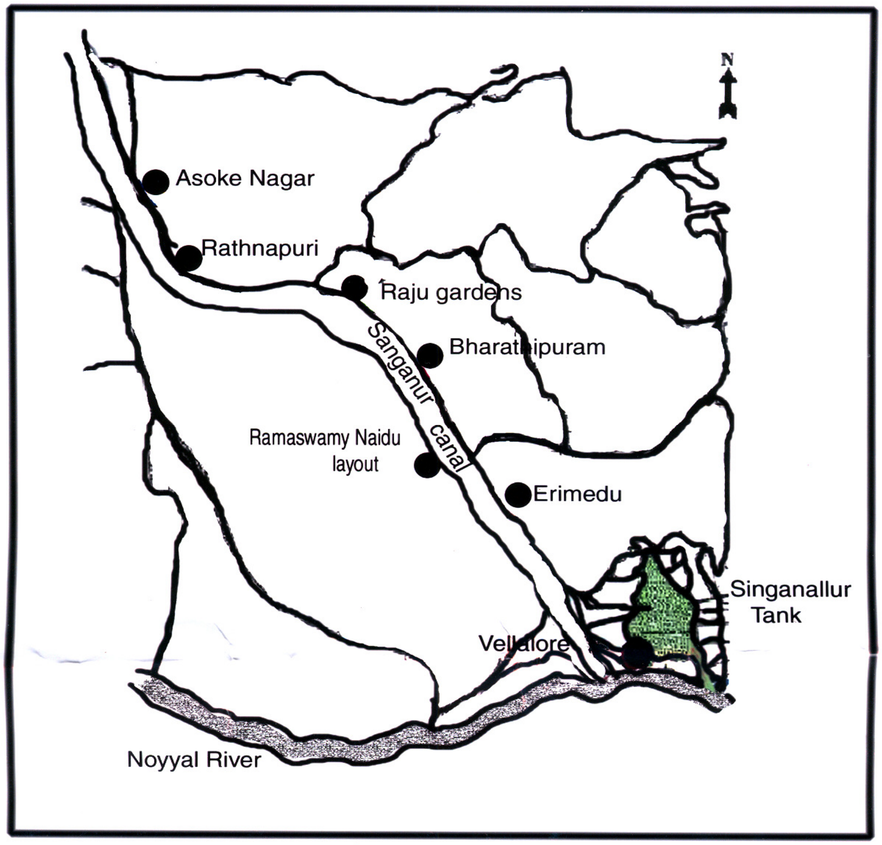

Fig.1: Course of Sanganur canal – The open drainage with different sampling stations.

at S_6 (12,000.00 mgl^{-1}) followed by S_5 (10,666.66 mgl^{-1}), S_7 values (5333.33mgl^{-1}) and S_2 (2666.67mgl^{-1}), while at S_2, S_3 and S_4 were lower than the stipulated standard of 2100.00mgl^{-1}. S_6 (Erimedu) where hospital waste is the main source for contributing to high level of total solids. At S_5 (Ramaswamy Naidu layout) soap company, dye testing unit contribute to total solids. S_3 is Rajugardens and S_7 is Vellalore, which receives mixed waste of domestic and industrial effluents which contribute to the total solids. S_2 (Rathnapuri) receives domestic sewage and flour mill effluent which contribute to the total solids. S_1 (Asoke Nagar) receives only domestic sewage and S_4 (Bharathipuram) receives industrial effluent which contribute to the low total solids. So nature, type and time of retention of domestic sewage and industrial effluent in each station decide upon the total solids.

Wide fluctuations in the level of total hardness was noted among the sampling stations, maximum being at S_1 (533.33mgl^{-1}) followed by S_7 (330.00mgl^{-1}), S_5 (93.33mgl^{-1}), S_3 (86.66mgl^{-1}), S_4 (80.00mgl^{-1}) and S_6 (60. 00mgl^{-1}). According to Murali and Stathyanarayana (2001) the hardness is mainly due to presence of calcium, magnesium and chlorides in the domestic wastes.

Dissolved oxygen was maximum at S_4 (7.81mgl^{-1}) followed by S_3 (6.09mgl^{-1}), S_1 (4.41mgl^{-1}), S_7 (4.31mgl^{-1}) and S_2 (4.22mgl^{-1}) while it was minimum at S_6 (3.57mgl^{-1}) and S_1 (3.38mgl^{-1}). Generally whenever DO increases BOD and COD will decrease. But in the present work the selected stations S_3 and S_4 with DO as 3.38mgl^{-1}, 7.81mgl^{-1} respectively are totally different in nature. S_3 (Rajugardens) is a domestic area receives domestic waste water with more organic materials. So it has less DO and more BOD and COD. This municipal sewage water flows for some distance during which time the atmospheric oxygen gets dissolved and reaches the S_4 station (Bharathipuram). So municipal sewage water collected from this station has more DO but BOD and COD have not reduced, as Chemical oxygen demand and biological oxygen demand require time for their reactions. Maximum level was due to rheological phenomenon as well as the self purification capacity of flowing water (Singh and Trivedi, 1979). Minimum level was due to chemical impurities, stagnant condition and microbiological growth in water (Bhuvaneswaran *et al*., 1999).

BOD was maximum at S_4 (384.67mgl^{-1}) followed by S_5 (365.87mgl^{-1}), S_2, S_3 (347.10mgl^{-1}), S_6 (234.57mgl^{-1}) and S_7 (123.33mgl^{-1}) while a minimum of 66.66mgl^{-1} at S_1 were recorded. The values at all the stations were found to be beyond the permissible limit. Kandhasamy and Santhaguru (1994) have reported that the higher BOD may be due to higher organic load and higher growth of total micro organisms. COD level was maximum at S_6 (1800.00mgl^{-1}) followed by S_4 (746.67mgl^{-1}), S_1 (328.00mgl^{-1}), S_7 (277.33mgl^{-1}) S_2 (272. 00mgl^{-1}) and S_5

(266.67mgl^{-1}) which may be due to the incessant flowing of sewages in these stations and COD changes according to season (Mishra *et al*., 1990). The values at all the stations were found to be beyond the permissible limit.

Chloride was maximum at S_6 (468.60mgl^{-1}) followed by S_1 (428.37mgl^{-1}), S_4 (324.23mgl^{-1}), S_3 (291.10mgl^{-1}) S_2 (260.33mgl^{-1}) and S_7 (227.17mgl^{-1}) and minimum was found in S_5 (78.10mgl^{-1}). The level of chloride at all the stations was found to be within the permissible limit. High level of chlorides may be due to heavy sewage dumping (Bhuvaneswaran *et al*., 1999).

Decreasing in the level of sulphate was noted in S_1, S_7 and S_6, (80.00mgl^{-1}, 40.00mgl^{-1} and 10.00mgl^{-1} respectively). Same levels were recorded in S_2, S_3, S_4, and S_5 (5.00mgl^{-1}). Sulphate level at all the stations were found to be within the permissible limit. Sulphates are often present as calcium sulphates in natural waters and more in sewage.

Phosphate was maximum at S_4 (32.67mgl^{-1}) followed by S_7 (9.47mgl^{-1}) S_6 (6.93mgl^{-1}) and S_3 (6.40mgl^{-1}) and minimum was observed in S_3 (5.20mgl^{-1}), S_2 (4.87mgl^{-1}) and S_1 (4.20mgl^{-1}). The high phosphate concentration was due to discharge of untreated industrial and domestic wastes (Chakrabarty *et al*., 1959 and Hannan and Young, 1974).

Nitrite level was found to be high at S_7 (19.84 mgl^{-1}) S_4 (9.26 mg1^{-1}) and same values were observed in S_2, S_3, S_4, and S_5 (7.94 mgl^{-1}) and S_1 and S_6 (5.95 mgl^{-1}). According to Grasshoff (1983) in water bodies, where toxic conditions change into anoxic, thin layer of nitrite content may occur together with low levels of oxygen.

Ammonical nitrogen was maximum at S_2 (61.63mgl^{-1}) followed by S_1 (56.03mgl^{-1}) and S_4 (28.01mgl^{-1}) and the same results were obtained in S_5 and S_7 (33.62 mgl^{-1}) S_3 and S_6 (22.41mgl^{-1}). The level of ammoniacal nitrogen exceeded the permissible limit at S_1 and S_2. Das *et al.* (2003) reported that high organic pollutant load resulted in marked increase in ammoniacal nitrogen value in drains and may be due to decaying organic matter.

Results of this study recommends the treatments of domestic sewage and industrial effluent water before letting into the open drainage, so that the quality criteria of the Sanganur canal water will satisfy the ISI quality criteria set for inland surface water for irrigation and fish culture.

Acknowledgement

The authors are thankful to the authorities of Avinashilingam Deemed University, Coimbatore - 641 043 for the facilities provided.

References

APHA.: Standard methods for the examination of water and waste water. 18th ed. American Public Health Association Publications, Washington, DC, (1992).

Bhuvaneswaran, N., G. Santhalakshmi and S. Rajeswari: Water quality of river Adyar in Chennai city – The river a boon or a bane *IJEP,* **19 (6),** 412-415 (1999).

Chakrabarty, R.D., P. Roy and S.G. Singh: A quantitative study of plankton and physicochemical conditions of river Yamuna in 1954. *Indian J. Fish,* **6,** 186-203 (1959).

Das, A.C., B.K. Baruah, D. Baruah and S.Sengupta: Study on wetlands of Guwahati city: Two water quality of rivers and drains. *Poll.Res*., **22 (1),** 117-119, (2003).

Grasshoff, K.: *In:* Methods of sea water analysis. (*Eds:* K. Grasshoff, M. Ehrhardt and K. Kremling). Nerling Chemic, Weirheim, pp. 31-59, (1983).

Hannan, H.H. and W.C. Young: The influence of a deep storage reservoir on the physicochemical limnology of a central taxas river. *Hydrobiologia,* **447,** 177-207 (1974).

Kandhasamy, M. and K. Santhaguru: Influence of sewage on physicochemical characteristic of the river Vaigai. *J. Ecobiol.,* **6 (4),** 315-317 (1994).

Manivasakam, N.: Industrial effluents – Origin, characteristics, effects, analysis and treatment, Sakthi Publications, Coimbatore, (1987).

Mishra, P.C., M.C. Dash and G.K. Kar: *In:* River pollution in India, (*Eds:* R.K.Trivedy). Ashish Publishing House, New Delhi, (1990).

Murali, M. and T. Satyanarayana: A study on source of water pollution at Machilipatnam, A.P., *Poll. Res.,* ***20 (2),*** 471- 473 (2001).

Singh, S.K. and R.N. Trivedi: The impact of sewage water on the quality of Ganga water. *Mendel*., **6 (1),** 99-101 (1979).

Sreenivasan, A. and R. Sounderaraj: Effects of certain wastes on the water quality and fisheries of rivers Cauvery and Bhavani. *J.Environ. Hlth.,* **9,** 13-21 (1967).

Trivedy, R.K.: Studies on the biological characteristics of the river Krishna in Maharastra with reference to human activity and pollution. Technical Report submitted to Dept.of Environment, Ministry of Environ. Forest and Wild Life, New Delhi, (1988).

Correspondence to:
Dr. S. Binu Kumari, Lecturer
Department of Zoology
Chikkanna Government Arts College
Tirupur – 641 602 (Tamil Nadu), India