International Research Journal of Environment Sciences ISSN 2319–1414
Vol. 4(5), 28-33, May (2015) Int. Res. J. Environment Sci.

Physico chemical analysis of water and soil in Sengulam and Mangulam in Dindigul district, Tamil Nadu, India

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Available online at: www.isca.in, www.isca.me
Received 18th February 2015, revised 4th March 2015, accepted 13th April 2015

Abstract

Research paper of some water analysis reports with physico-chemical parameters have been given for the exploring parameter study. Guidelines of different physico-chemical parameters also have been given for comparing the value of real water sample. In Sengulam wetland the physico- chemical analysis of water and soil which is highly polluted compare to Mangulam wetland. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. The temperature is maximum in April and May and minimum in December and January.

Keywords: Physico chemical parameters, mangulam and sengulam.

Introduction

Wetlands may support both aquatic and terrestrial species. Wetlands vary widely because of regional and local difference in soils, topography, climate, hydrology, water chemistry, existing vegetation and other factors. Wetlands are defined as areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil conditions[1]. A variety of municipal, industrial, agricultural, and urban runoff wastewaters[2]. This systems range in size from less than 200m^2 to over 40,000 ha. Wetlands ecosystem can act as sources, s. Thus, the physical and chemical properties of freshwater bodies are characteristics of the climatic, geochemical, geomorphalogical as well as pollution conditions prevailing in the drainage basin and the underflying aquifer[3].

Water is one of the most important and abundant compounds of the ecosystem. All living organisms on the earth need water for their survival and growth. As of now only earth is the planet having about 70 % of water. But due to increased human population, industrialization, use of fertilizers in the agriculture and man-made activity it is highly polluted with different harmful contaminants. Therefore it is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. It is difficult to understand the biological phenomenon fully because the chemistry of water revels much about the metabolism of the ecosystem and explains the general hydro - biological relationship[4] heavy metals such as Pb, Cr, Fe, Hg etc. are of special concern because they produce water or chronic poisoning in aquatic animals. Having mainly excessive amounts of heavy metals such as Pb, Cr and Fe, as well as heavy metals from industrial processes are of special concern because they produce water or chronic poisoning in aquatic animals[5]. High levels of pollutants mainly organic matter in river water cause an increase in biological oxygen demand[6], chemical oxygen demand, total dissolved solids, total suspended solids and fecal coli form. They make water unsuitable for drinking, irrigation or any other use[7] Most of the rivers in the urban areas of the developing countries are the ends of effluents discharged from the industries. African countries and Asian countries experiencing rapid industrial growth and this is making environmental conservation a difficult task[8].

Tank irrigation is one of the oldest and significant sources of irrigation in India and is particularly in south India[9]. The tanks occupy vital role in the irrigation as well as local ecosystem in the semi-arid and regions of South India. This perennial tank provides multiple uses like source of drinking water for uncountable rural and urban communities and livestock, fish culture, recharge of ground water, control of floods etc[10]. As water is one of the most important compounds of the ecosystem, but due to increased human population, industrialization, use of fertilizers in the agriculture and man-made activity. The natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to pollute water quality and depletion of aquatic biota. It is therefore necessary that the quality of drinking water should be checked at regular time of interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. It is difficult to understand the biological phenomena fully because the chemistry of water revels much about the metabolism of the ecosystem and explain the general hydro-biological relationship.

Pollution of the environment is one of horrible ecological crisis to which they are subjected today. Most of the activities of man has created adverse effects on all living organisms in the biosphere, thus the pollution is generally defined as the addition of the constituents of water, air or land which adversely after the natural quality of the environment. Tanneries generate waste water in the range of 30-35 l/kg skin/hide processed with variable pH and high concentration of suspended solids, BOD, COD, tanning's including chromium[11]. The tanning industries are especially large contributors of chromium pollution in India.

The leather industry is an important foreign exchange earner for India. The states of Tamil Nadu, West Bengal and Uttar Pradesh together have 88 percent of the tannery units of the country. Tanners use a large number of chemicals during the process, discharging toxic wastes into the rivers and degrading agricultural land. All the 68 tanneries in Dindigul, Tamil Nadu, South India, are situated within a 5 km distance from the centre of the town. Several of them have been in existence for thirty to forty years. Effluents from the tanneries are discharged into streams which drain into ponds, thereby polluting the ground water sources and cultivable land. Leather processing requires large amount of chemicals like sodium, chloride, chromium sulphate, calcium salts, ammonium salts, sodium sulphide, acids, alkalis, fat, liquor and organic dyes. However, one of the major emerging environmental problems in the tanning industry is the disposal of chromium contaminated sludge produced as a by-product of waste water treatment. Wetland birds comprise a group of birds which have been studied for a long time. North America and European countries have led the research in this field significantly.

Pollution due to tannery effluents a variety of chemicals are used in the tanning industries, including lime, sodium chloride, sodium carbonate, ammonium chloride, sulphuric acid, tannins and dyes. All tanneries need a large amount of water for processing leather and depend on ground water sources for their daily requirements. The discharged effluents from the processing units are stored in large lagoons and pollution occurs as the dissolved salts percolate into the surrounding soil. Thus, they ground water sources and cultivable land. Thus, the ground water sources are exploited to their fullest potential and polluted to a great extent. A state of severe pollution results from the cluster of tanneries in close proximity to each other. The objectives of the present study was to analyse the Physico chemical characteristics of water and soil.

Methodology

Dindigul is a town and municipality in the Tamil Nadu state of southern India. Dindigul is known for its leather tanning industry. Sengulam is located in Begambur. Tanning waste water was collected near the industry into a pond. The total area was covered by 16 acres and it is filled with *Prosopis juliflora*, sp. sagitifolia, Aerva lantana plants (figure-1). Its tender and cool climate of nature attracts the birds. The Mangulam pond was also located in Dindigul district at the distance of 2 Km from the Sangulam pond. Mangulam is a normal pond water. It was also smaller in size than the Sangulam pond. The vegetation of the area was studied by identifying the plants. The data were expressed as arithmetic mean ± standard deviation and correlation.

Results and Discussion

The average concentration, Acceptable or permissible limits (CPEEO Standards) for the water samples are presented in the (table 1 and 2). From the results, the colour of the Sengulam water sample is Black. The colour is usually due to contaminant that has to be recognized in the waste water that affects the aesthetics, water transperancy and gas solubility of water bodies. In Mangulam the water is clear and colourless (table-3 and 4).

Turbidity: Turbidity of water was 92 to 296 mg/l mostly exceeding from December to May than the Acceptable limit 5 mg/l. The Turbidity of the water in Mangulam was 4 to 6 more or less same in the acceptable limit.

Table-1
Physical examination of water sample from Sengulam Wetland

Physical Examinaton	Acceptable Limit (mg/l)	Exceeding Limit (mg/l)	Sengulam					
			Dec	Jan	Feb	Mar	April	May
Colour	-	-	Black	Black	Black	Black	Black	Black
Odour	Unobjectionable	Unobjectionable	objectionable	objectionable	objectionable	objectionable	objectionable	objectionable
Turbidity NT Units	5	10	92	34	275	280	294	296
Total diss. Solids mg/l	500	2000	14630	11410	19796	10250	21200	22500
Electrical Conductivity Micro mho/cm	–	–	20900	16300	28280	26280	21290	23300

Table-2
Chemical examination of water sample from Sengulam Wetland

Chemical Examination	Sengulam							
pH	7.0 – 8.5	6.5 – 8.5	8. 1	7. 6	7. 8	7. 6	7. 8	7. 9
Total Alkalinity as $CaCo_3$	200	600	700	600	1000	1200	1500	1600
Total Hardness	300	600	2000	2000	2000	2400	2500	2500
Calcium as Ca	75	200	400	440	400	400	400	440
Magnesium as Mg	30	100	240	264	240	250	250	260
Iron as Iron	0. 3	1. 0	2	10	10	20	10	10
Manganese as Mn_3	0. 1	0. 3	0	0	0	0	0	0
Ammonia as NH_3	_	_	400	40	60	80	80	60
Nitrite as NO_2	_	_	0. 1	2	2	2	2	2
Nitrate as NO_3	45	45	20	25	40	50	55	57
Chloride as Cl	250	1000	5000	5000	6000	7000	8000	8500
Flouride as F	1. 0	1. 5	1. 2	1. 2	1. 2	1. 2	1. 2	1. 2
Sulphate as SO_4	200	400	3300	600	800	900	800	900
Phosphate as PO_4	_	_	2	2	10	15	20	25
Tidy's Test (4 hrs) as O_2	_	_	88. 0	100. 0	17. 0	20. 0	25. 0	25. 0
Dissolved Oxygen	_	_	1	1	3	5	8	10
Bio-Chemical Oxygen Demand		_	264	450	48	100	80	70
Chemical Oxygen Demand	_	_	792	1350	133	120	170	150

Table-3
Physical examination of water sample from Mangulam Wetland

Physical Examination	Acceptable Limit (mg/l)	Exceeding Limit (mg/l)	Mangulam					
			Dec	Jan	Feb	March	April	May
Colour	-	-	Clear	Clear	Clear	Clear	Clear	Clear
Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Turbidity NT Units	5	10	4	6	4	6	4	6
Total diss. Solids mg/l	500	2000	1456	1715	3080	3200	3300	3500
Electrical Conductivity Micro mho/cm	–	–	2080	2450	4400	5000	5500	5600

Electrical Conductivity: In Sengulam the EC of water between the month December to May is measured as 20900 to 23300 mg/l. Increase in EC values indicates the presence of higher concentration of ions. The same result was that EC of Anantpur samples being it high when compared to Sansarpur samples. The value of EC was 2080 to 5600 mg/l in Mangulam.

Total dissolved solids: In Sengulam the value of total dissolved solids was (14630 to 22500 mg/l) high, when compared to the value of TDS (1456 to 3500 mg/l) in Mangulam. Because the tannery waste water are added in the Sengulam. In Sengulam value of TDS 14630 to 22500 mg/l, its higher than the acceptable limit 500 mg/l. The TDS may increases the salinity of the water, so it does not used for irrigation and drinking purpose. Consumption of water with high concentration of TDS has been reported to causes the disorders of alimentary canal, respiratory system, nervous system, coronary system, besides causing miscarriage and cancer.

Alkalinity: The alkaline capacity of water is neutralized with acids and it is undesirable. Alkalinity value of Sengulam water was found to be 700 to 1600 mg/l from December to May. These values are higher than the acceptable limit 200 mg/l. In the Alkalinity value of Mangulam was 100 mg/l, it is very low when compared to acceptable limit 200 mg/l. Because less amount of salinity was present in Mangulam water.

pH: The discharge of waste water into water bodies may cause a drop or increase their pH. In Sengulam the Ph values of water is measured as 7.6 to 8.1 and in mangulam the values are in between 7.3 to 8.1 during December to May. In both the wetland water has alkaline in nature.

Total Hardness: In Sengulam total hardness calcium,

magnesium content of the water was found to be 2000 to 2500 mg/l, 400 to 440 mg/l, 240 to 260 mg/l in the sengulam. But in mangulam was total hardness (800 to 1500 mg/l), calcium (160 to 400 mg/l) and magnesium (96–240 mg/l). The excess amount of calcium and magnesium causes the irrigation of water. Since its application increases due to of soil salinity.

In Sengulam Iron values are found to be 2 to 10 mg/l from December to May. These values are higher than the acceptable limit. The manganese, ammonia and nitrite (0 mg/l, 400 to 60 mg/l and 0. 1 to 2 mg/l). in mangulam the iron value was 0. 2 to 0. 2 mg/l, its lower than the acceptable limit. Unlike manganese, ammonia and nitrite value was (0 mg/l, 0. 5 to 1 mg/l and 0. 02 to 0. 5 mg/l).

Dissolved Oxygen: Dissolved oxygen (DO), the most important parameter of water quality was found (1-10 mg/l) in Sengulam and Mangulam was 1-13 mg/l and therefore, DO value was nil in effluent samples as reported by Nanda Kumar et al.

Bio-Chemical Oxygen Demand: The high BOD levels are indicates the pollution strength of the waste water. In Sengulam the BOD value was 264 to 70 mg/l. In Mangulam the BOD value was 13 to 57 mg/l. When compared to Sengulam water it was very low.

Chemical Oxygen Demand: High COD levels indicate toxic state of the waste water along with presence of biologically resistant organic substance. The value of COD from December to May 792 to 150 mg/l in Sengulam. The values are high when compared to Mangulam 35 to 25 mg/l.

From the December to May the level of chloride, sulphate and phosphate (5000 to 8500 mg/l, 3300 to 900 mg/l and 2 to 25 mg/l and Tidy's test 4 hrs as oxygen 88. 0 to 25. 0 mg/l was noted as higher than the mangulam value was chloride 600 to 1800 mg/l, sulphate 100 to 8 mg/l, phosphate 0. 2 to 0. 2 mg/l and Tidy's test 2. 0 to 4. 2 mg/l.

Soil Analysis: The soil elements from sengulam and mangulam were analysed for six metals such as (N, I, P, Mn, Z and Cu). In sengulam the increase concentration of nitrogen ranges from 70 to 74 (February and December) and minimum nitrogen value was recorded in march. at the same time the iron value was 27. 8 ppm increased in January and it was decreased 5. 50 ppm in March. The Potassium value was maximum in the month of January 121 ppm and minimum in December 6 ppm (figure-1).

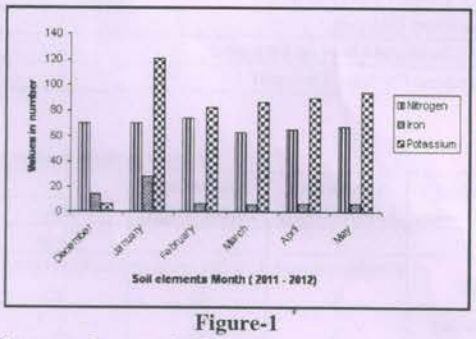
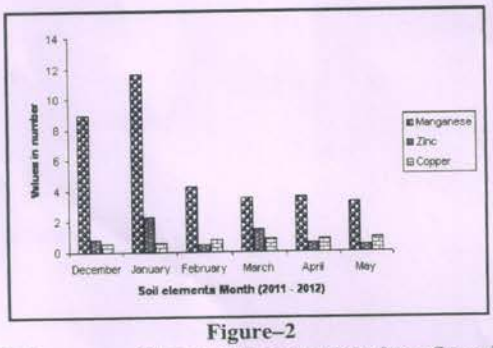


Figure-1
Soil Nitrogen, Iron and Potassium values from Sengulam Wetland during December 2011 to May 2012

Table-4
Chemical examination of water sample from Mangulam Wetland

Chemical Examination	Mangulam							
pH	7. 0 – 8. 5	6. 5 – 8. 5	7. 7	7. 3	8. 1	8. 1	8. 1	7. 6
Total Alkalinity as $CaCo_3$	200	600	100	100	100	100	100	100
Total Hardness	300	600	800	800	1700	1600	1800	1500
Calcium as Ca	75	200	160	160	340	360	250	400
Magnesium as Mg	30	100	96	96	200	220	250	240
Iron as Iron	0. 3	1. 0	0. 2	1	1	1	0. 2	0. 2
Manganese as Mn_3	0. 1	0. 3	0	0	0	0	0	0
Ammonia as NH_3	–	–	0. 5	0. 5	1	1	0. 5	1
Nitrite as NO_2	–	–	0. 02	0. 02	0. 04	0. 5	0. 02	0. 5
Nitrate as NO_3	45	45	6	10	12	16	18	20
Chloride as Cl	250	1000	600	800	1100	1400	1500	1800
Flouride as F	1. 0	1. 5	0. 5	1	1	1	1	0. 5
Sulphate as SO_4	200	400	100	20	15	1	10	8
Phosphate as PO_4	–	–	0. 2	0. 2	0. 5	1	0. 5	0. 2
Tidy's Test (4 hrs) as O_2	–	–	4. 2	10. 0	2. 0	4. 0	5. 0	6. 0
Dissolved Oxygen	–	–	1	1	7	8	10	13
Bio-Chemical Oxygen Demand	–	–	13	57	6	10	20	30
Chemical Oxygen Demand	–	–	34	171	16	20	18	25

The accumulation of micronutrients such as the Manganese was too high in December 11. 66 ppm and it was low in May 3. 25 ppm. The amount of zinc was high in January 2. 28 ppm and low in 0. 50 ppm. Copper was high in February 0. 84 ppm and it was low in December 0. 56 ppm (figure-2).



Figure–2
Soil Manganese, Zinc and Copper values from Sengulam Wetland during December 2011 to May 2012

At the same time the increase concentration of nitrogen was 80 ppm and it was low in January 66 ppm. The accumulation of micronutrients such as Iron was high in January 66. 0 ppm and it was low in March 7. 58 ppm. The level of potassium was high in May 160 ppm and it was very low in December 8 ppm (figure-3).

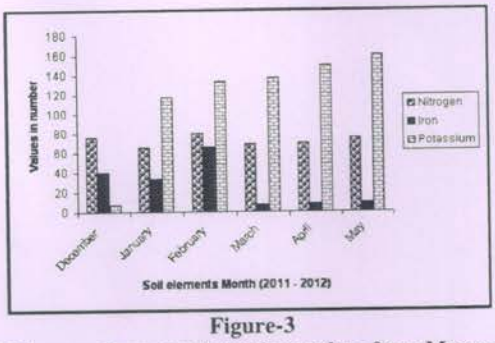


Figure-3
Soil Ntrogen, Iron and Potassium values from Mangulam Wetland during December 2011 to May 2012

Manganese was too high in January 24. 0 ppm and it was low in May 4. 00 ppm. The amount of zinc was high in February 4. 72 ppm and low in March 0. 44 ppm. Copper was high in February 2. 94 ppm and it was low in January 0. 06 ppm (figure-4).

Conclusion

In Sengulam wetland the Physico- chemical analysis of water and soil which is highly polluted compare to Mangulam wetland. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. The temperature is maximum in April and May and minimum in December and January. Some water analysis reports with physico-chemical parameters have been given for the exploring parameter study. Guidelines of different physico-chemical parameters also have been given for comparing the value of real water sample.

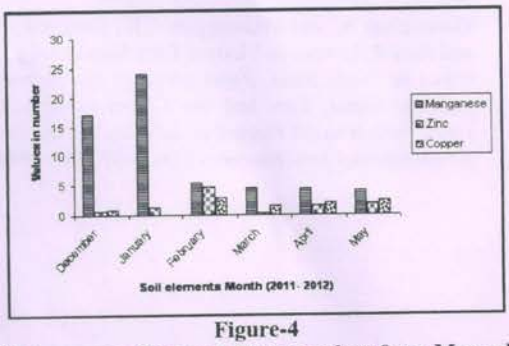


Figure-4
Soil Manganese, Zinc and Copper values from Mangulam Wetlands during December 2011 to May 2012

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