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Assessment of the Contamination from the Tanneries & Dyeing Industries on to Kalingarayan Canal of Tamilnadu

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Abstract: A systematic study has been carried out to assess the water contamination and the effect of the tanneries & dyeing industries effluents on Kalingarayan Canal, Erode District, Tamil Nadu. Ten sampling locations were selected in the way of the canal from its origin point and the water samples were collected from the selected sampling points. The samples were analyzed for major physical and chemical water quality parameters like pH, Turbidity, Color, TDS, Electrical Conductivity, Chloride, Carbonates, Bicarbonates, Total hardness, Calcium, Magnesium, Sulphates, Dissolved Oxygen, COD, BOD, Nitrate N, Nitrite N, Potassium & Sodium. It was found from the analytical report that the Kalingarayan canal water was contaminated by discharge of the effluents from the tanneries & dyeing industries which are located nearby. The present investigation shows that a constant variation in different parameters in different locations. So it is highly important to take periodical monitoring of the Canal water quality in this region for future sustainability.

Key words: Contamination Assessment, Tanneries & Dyeing Industries, Kalingarayan Canal ,Tamilnadu.

1.0 INTRODUCTION

The river of Bhavani, the second largest river in Tamil Nadu begins in the upper regions of Nilgiris of the Western Ghats. In the way of Bhavani River, there are many large scale industries such as chemical manufacturers, sugar mills, textile units, tanneries etc.., are located in the riverbank and they are using the water from the river and discharging the treated and untreated effluents into the river. The Villagers living in the downstream are using the water for their irrigation, drinking and other domestic activities. It crosses the districts of Coimbatore, Nilgiri and Erode and finally merging with the river Cauvery.

1.1 STUDY AREA

In Erode district, a small quantity of river is diverted for the irrigation purpose in a canal, named as Kalingarayan Canal near Bhavani Town. The Kalingarayan Canal is a 56-mile long irrigation canal in the Erode region of Tamil Nadu, India. It was constructed by Kongu chieftain Kalingarayan and completed in the year 1283. The canal was designed with a meandering route to maximize the amount of land which benefited. The total length of the canal is approximately 92 km passing entirely through the district of Erode, Tamil Nadu and as per the survey conducted, about 150 dyeing units and 20 tanneries are in operation in catchment area and expected to discharge the trade effluent (both treated & untreated) either directly or indirectly through drain. This has resulted in poor quality and low yield of crops which were irrigated with the canal water. In addition, health status of people using the canal water for domestic purposes has been reported deteriorated. The increase in the concentration of the dissolved solids in the canal water indicates the mixing of untreated effluent.

This present study is to assess the quality of the canal water and the impacts of the effluents from the industries. This study will be very helpful to understand the impact/evaluation of the rate of dumping of effluent water in Kalingarayan Canal and impact on the quality of water in terms of irrigation and the impacts onto the environment.

2.0 MATERIAL AND METHODS

In this investigation, 10 water samples were collected from various sampling points in the way of the Canal during the month of September 2009. The water samples were collected by holding the glass stoppered sterile bottles near its base and the temperature noted immediately at the sampling site. The samples were transported to the laboratory duly covered with tight lid and kept in an ice box to avoid the unpredictable changes in physico-chemical characteristics. All the physico-chemical parameters were analyzed as per the method described in "Standard methods for the examination of water and wastewater", American Public Health Association (APHA)[1]. The parameters present in the water sample can be calculated by using various methods[2-3]. The samples for BOD were seeded and incubated for 5 days at 20°C. All instruments were standardized before use; the solutions were prepared from AR grade chemicals and dissolved in double distilled water.

Table 1 – Physico Chemical Characteristics of Water Samples

Parameters	Unit	PWD office-Storage Dam	Konavaikal	RN Pudur	Sunnambu Odai	Before Agraharam	After Agraharam	Vairapalayam	Karungalpalayam	Valaiyakara Street	Vendipalayam
Temperature	^{0}C	28	28	29	28	29	29	30	30	29	29
pH		7.41	7.57	7.66	7.75	7.87	7.60	7.60	7.52	7.44	7.36
Turbidity	NTU	6.39	5.82	4.49	4.15	4.52	3.85	3.72	3.44	3.21	2.80
Color	Hazen	10	10	10	15	15	15	20	20	20	20
Total Dissolved Solids	mg/L	219	223	235	238	246	269	277	285	298	306
Conductivity	µS/cm	332	338	356	361	373	408	420	432	452	464
Chloride	mg/L	22	22	28	28	31	39	39	42	45	45
CO_3^{2-}	mg/L	2	2	2	4	4	4	4	2	2	0
HCO_3^-	mg/L	115	115	119	117	121	121	121	132	132	138
Total Alkalinity	mg/L	117	117	121	121	125	125	125	134	134	138
Total Hardness	mg/L	114	114	126	126	126	131	131	131	135	135
Ca	mg/L	21	22	24	23	24	28	29	29	30	30
Mg	mg/L	15	14	16	17	16	15	14	14	14	14
Sulphate	mg/L	13	13	13	15	15	16	17	17	20	20
Dissolved Oxygen	mg/L	4.4	4	3.8	2.6	1.6	1.1	1.1	0.7	0.7	0.7
COD	mg/L	24	24	28	28	32	32	34	34	36	36
BOD	mg/L	2	2	4	4	4	4	4	5	6	6
NO_3 N	mg/L	3.12	2.93	2.42	2.11	1.9	1.77	1.83	1.31	1.13	1.17
NO_2 N	mg/L	*	0.22	0.46	0.52	0.57	0.81	0.87	1.23	1.57	1.48
Potassium	mg/L	3	3	3	3	3	3	4	4	4	4

Sodium	mg/L	27	30	36	39	41	46	50	56	61	61
SAR value[4]		0.90	1.00	0.98	1.06	1.12	1.17	1.28	1.43	1.46	1.51
RSC value[4]		-0.33	-0.33	-0.51	-0.47	-0.41	-0.49	-0.49	-0.38	-0.47	-0.43

* Below the Detection Limit

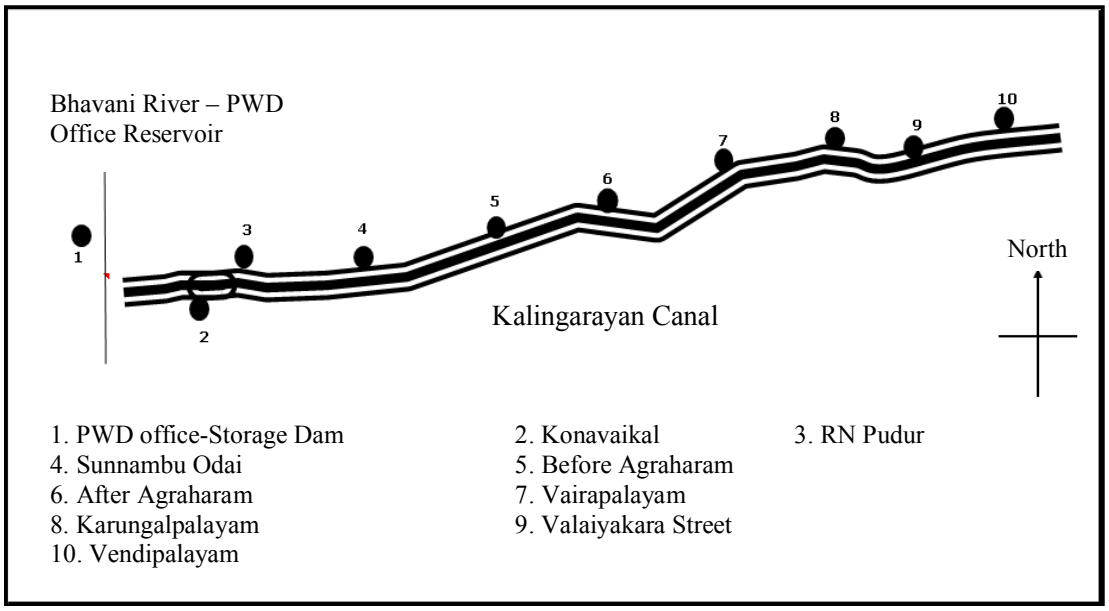

Figure 1 – Locations of various sampling points

3.0 RESULTS AND DISCUSSION

The physico-chemical characteristics of the water samples collected from the various sampling points were given in the table and sampling points are also indicated in the map.

The value of temperature for all samples is recorded 28^0C as the minimum and 30^0C as the maximum. The parameter of color is found as 10 Hazen units at the starting point of the Canal at PWD office storage dam but it increased as 20 Hazen units when it reaches to 9th sampling point at Valaiyakara Street.

The conductivity and total dissolved solids are in the amount of 332µS/cm and 219mg/L respectively at PWD office storage dam. But the conductivity and total dissolved solids were drastically increased to 452µS/cm and 298mg/L respectively when it reaches to 9th sampling point at Valaiyakara Street. The standard value for Electrical Conductivity is 1500 µS/cm according to WHO[5]. Electrical conductivity (EC) of water is a direct function of its total dissolved salts[6]. Hence it is an index to represent the total concentration of soluble salts in water[7].

As discussed earlier, there are 150 dyeing units and 20 leather tanneries are in operation in catchments area. This is clearly indicated that there is the discharge the trade effluent (both treated & untreated) either directly or indirectly through drain from the above said industries. Total Hardness was also increased from 114mg/L to 135mg/L which indicates the calcium and magnesium mixing from outside sources. Magnesium usually occurs in lesser concentration than calcium due to the fact that the dissolution of magnesium rich minerals is slow process and that of calcium is more abundant in the earth's crust[8]. Though it is within the range of the norms of 200mg/L, the hardness of the water was slightly increased rather than its origin.

The sodium and chloride content is considerably raised from 27 mg/L & 22mg/L to 61mg/L & 45mg/L respectively. It may have the chance of mixing from the discharge of dyeing industries during their bleaching process with sodium chloride salt. Sodium content adversely affects the soils nutrients up taking capacity[9]. Excess chloride concentration indicates the contamination from the sewage; it requires the engineering controls to be adopted on the stream. Effect of chloride is to reduce

the DO concentration of the stream and to increase the salinity of water.

Sodium accumulates in the soil when the amounts added in wastes exceed the amounts removed by plant growth, leaching and other means. There are the losses in productivity in terms of yield during the harvesting time in agriculture due to salinity and water logging. Concentration of basic cations Viz., Na, Ca, & Mg ultimately influences the SAR values (Sodium Adsorption Ratio) in soil. The sodium hazard is also increased if the water contains a high concentration of bicarbonate ions, for as the soil solution becomes more concentrated there is tendency for Ca and Mg to precipitate as carbonate and for the relative proportion of sodium.

Dissolved Oxygen is one the most important factor for existence of an aquatic organism in water[10]. It is of a prime importance factor in natural water both as regular of metabolic process of biotic community and indicator of aquatic health. From our analysis report, the DO content is drastically reduced from 4.4 mg/L to 0.7mg/L due to the mixing of the chemical effluents and it demands oxygen for microorganisms to degrade the organic waste. Since the depletion of the oxygen, the BOD & COD is slightly increased, gives the high impact of the fishes in the canal. When the water flow is low in the canal, the true color of water in Kalingarayan canal is shown as reddish due its contamination from the industrial effluents which is not diluted.

The presence of Nitrate in water indicates that the organic pollution of the biological decomposition of nitrogenous organic matter such as sewage and animal wastes contribute nitrite. Nitrite may also enter into a water supply through the discharge of nitrite treated cooling waters. Their presence indicates that the nitrogenous organic matter is undergoing oxidation or nitrification and that the process is not complete. In some cases, nitrates are also reduced to nitrites.

When this polluted water is irrigated it is evaporated and leaves salts caked on the surface, it finally spoil the texture of soil. Salts with poor internal drainage facilities are mainly responsible for accumulation of salt in the root zone. Between different sampled locations, there were considerable variations in the concentrations of these basic cations.

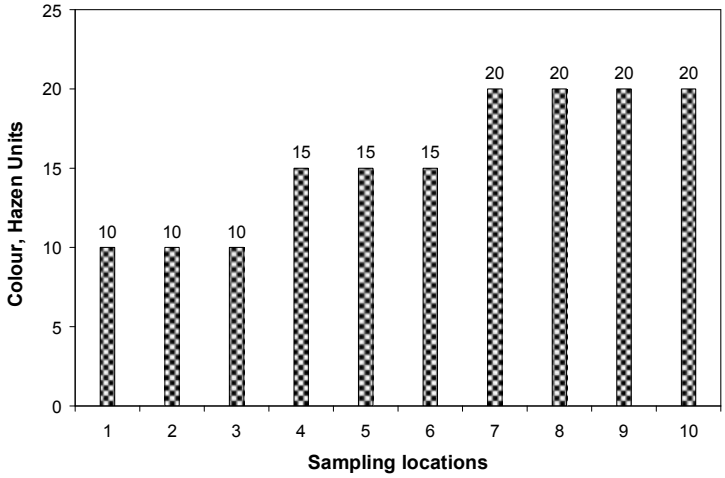

Figure 2 – Colour index of various water samples.

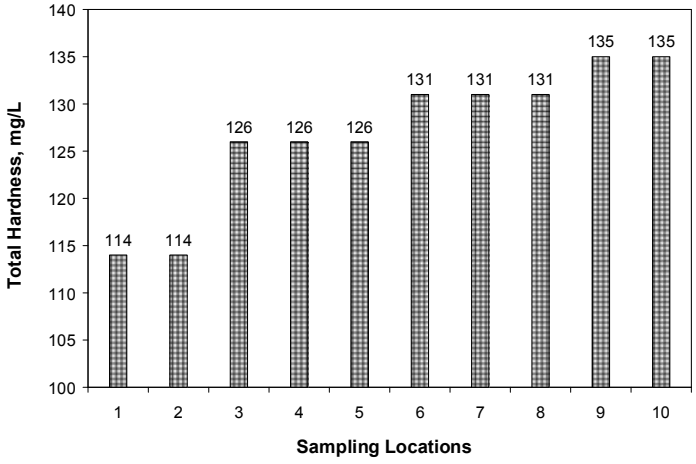

Figure 3 – Variation of Hardness values of various water samples.

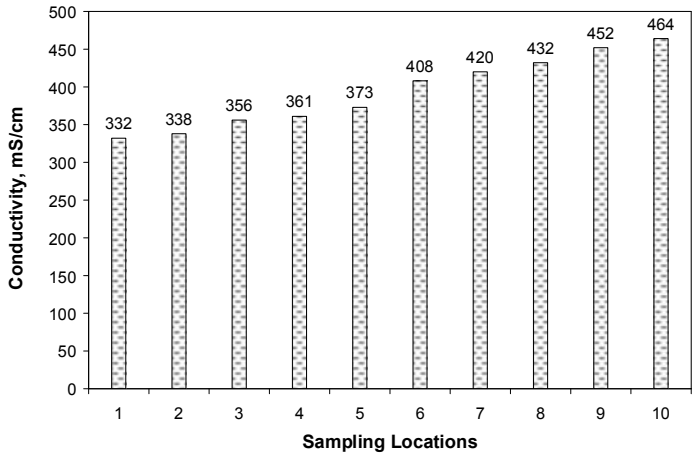

Figure 4 – Variation of Conductivity values of various water samples.

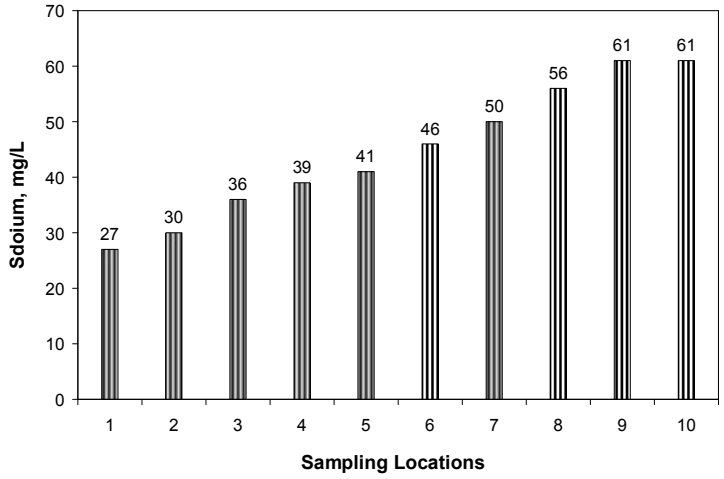

Figure 5 – Variation of Sodium values of various water samples.

4.0 CONCLUSIONS

From the above results, it is known that there are the contaminations in Kalingarayan Canal which will affect the agriculture soils in its way. The survey was conducted on the rainy season (August - October – rainy season of Tamil Nadu). When summer season (March – May), the chemical parameters will be still high at the source itself (storage dam) so that all contents of cations will be very high at the location of the last sampling point. Also if no water flows in the Canal, the bore well water also gets polluted by the concentrated water which discharges by the industries.

The analysis report shows that the contamination takes place from the location of RN Pudur to Valaiyakara Street where the all dyeing/leather industries are located. After the sampling point of Valaiyakara Street, all parameters is getting the consistence and no significant changes. It indicates that no contamination from the external sources and the location is also the full of agriculture land without any industry discharges.

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