Water Quality Evaluation of Industrial Creeks Found Around Surat City with Respect to Physico-Chemical Properties, Gujarat

Alpa Varsani* and Kapila Manoj

Department of Aquatic Biology, Veer Narmad South Gujarat University, Surat-395007, India.

***Abstract*- The present research work deals to assess water quality with reference to physico-chemical property of creeks located in Surat city, Gujarat. Water quality was checked for the parameters like pH, temperature, chloride, nitrite, nitrate, phosphate and silicate. Samples were collected from three sites during the month of October-2012 to March-2013. Pearson correlation was applied to express relation between various parameters. The study reveals that water may be contaminated due to the industrial effluent, sewage waste water and other organic pollutants.**

Keywords: **physico-chemical property, industrial effluent, sewage, creeks, Surat.**

I. INTRODUCTION

Water is one of the most important and abundant compounds of the ecosystem. It is also a crucial resource for agriculture, manufacturing and other human activities. It is a most essential basic component to all living being as most of the biochemical reactions that takes place through the metabolism and growth of living organisms involve water, which makes it vital resource required by living organisms. Now a days river is the most important and vulnerable freshwater system and plays a critical role in the sustenance of all life. In urban areas, the careless disposal of industrial effluents and other wastes in rivers and lacks may contribute greatly to the poor quality of river water [1]. Most of the rivers in the urban areas of the developing countries are the ends of effluents discharged from the industries. The decline in the quality of water in freshwater systems threatens its sustainability and has become a cause for concern. Aquatic ecosystems are affected by several health stressors that significantly deplete biodiversity. In the future, the loss of biodiversity and its effects are predicted to be greater for aquatic ecosystems than for terrestrial ecosystems [2]. Storm water runoff and discharge of sewage into rivers are two common ways that various nutrients enter the aquatic ecosystems resulting in the pollution of those systems [3],[4].

Many reasons like increased human population, industrialization, use of fertilizers in agriculture and manmade activity are responsible for water pollution. The water quality refers to the presence components of water in their optimum level such that it supports the growth of plants and animals. Temperature, pH, nutrients, dissolved oxygen etc. are some of the important factors that play a vital role for the growth of living organisms in the water body. Water quality indicates the relation of all hydrological properties including physical, chemical and biological properties of the water body. Hence water quality assessment involves analysis of physico-chemical, biological and microbiological parameters that reflects the biotic and abiotic status of ecosystem.

Many major and minor industries are located in or around Surat city are produce large amount of effluent in treated or untreated form which drained into different creeks nearer to those industries. Beside these public sewer and storm water was also drained through creeks. The Mindhola river system with in Surat city comprises of 7 natural tributaries (creeks) namely Koyali, Mithi, Kankara, Khajod, Bhedwad, Sonari and Varachha. These creeks reach ultimately to the Mindhola river. In the present study an attempt is made to study status of water quality in the creeks of Surat city, Gujarat. The study will also provide baseline data for future work on the river.

II. MATERIAL AND METHODS

A. Area of Study

Geographical location of Surat district is 21.0^{0} to 21.23^{0} N latitude and 72.38^{0} to 74.23^{0} E longitude. Surat is a city which drains its storm drainage through Mithi, Kankara, Khajod, Koyali, Bhedwad, Sonari and Varachcha (creek) into Mindhola river. The Creek receives domestic raw sewage as well as industrial waste water effluent from surrounding habitation and nearby industrial belt. There are many creeks flow through Surat city from which three sites were selected viz. site-1 Bhedwad Khadi (Bamroli), site -2 Mithi Khadi (Udhana) and site -3 Saniya Hamed (Saroli).

B. Physico-chemical Analysis

Study was conducted to check water quality during month of October-2012 to March-2013. Parameters selected to monitor during the study period were pH, Temperature, Chloride, Silicate, Phosphate, Nitrate and Nitrite. Water samples were collected from three sampling sites as described in standard method and transported to laboratory for analysis. Temperature and pH were recorded immediately at study site itself. Water samples were analyzed for various

physicochemical parameters using standard method [5] and [6].

C. Statistical Analysis

All the data obtained subjected to statistical analysis. In statistical analysis, a correlation developed between parameters by using PEARSONS Correlation technique.

III. Results and Discussion

The physicochemical properties of water samples collected from different sampling station illustrated in Table-1. Table-2 shows correlation coefficient of various physicochemical parameters of water by Pearson Correlation technique and Table-3 represented Descriptive Statistics.

Table I Physicochemical properties of water samples collected from different sampling sites

Month	Site	Temperature (°C)	pH	Chloride (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	Silicate (mg/l)
Oct-12	1	32	7.37	1079	0.04	2.17	0.76	28.30
	2	28	7.78	220	ND	8.08	0.60	25.49
	3	29	8.00	210	ND	0.51	1.32	25.25
Nov-12	1	26	7.39	1079	0.57	0.61	1.76	32.93
	2	25	7.61	162	0.13	0.80	3.00	29.20
	3	25	7.73	140	0.35	0.62	3.34	26.82
Dec-12	1	27	6.89	925	0.69	0.80	1.14	30.10
	2	26	7.42	246	0.10	3.15	2.13	26.18
	3	26	7.62	232	0.28	0.49	2.19	22.50
Jan-13	1	28	7.20	978	0.96	2.15	2.10	40.19
	2	27	7.50	250	0.72	1.28	1.43	32.50
	3	29	7.64	214	0.83	1.82	1.29	30.17
Feb-13	1	27	6.95	823	0.79	1.28	3.45	35.20
	2	26	7.38	327	0.62	0.82	2.16	31.17
	3	28	7.42	315	0.53	0.76	2.05	28.60
Mar-13	1	29	7.40	899	0.75	1.15	6.62	48.16
	2	30	7.60	315	0.19	1.10	4.89	40.28
	3	30	7.94	302	1.01	1.39	3.16	35.21

ND- Not Detected

Table II Correlation coefficient of various physico-chemical parameters of water by Pearson Correlation

	Temperature	pH	Chloride	Nitrite	Nitrate	Phosphate	Silicate
Temperature	1						
pH	.165	1					
Chloride	.268	-.690(**)	1				
Nitrite	.020	-.367	.321	1			
Nitrate	.158	.151	-.106	-.305	1		
Phosphate	.027	-.018	.053	.219	-.324	1	
Silicate	.317	-.294	.477(*)	.569(*)	-.173	.727(**)	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

TABLE III DESCRIPTIVE STATISTICS

	N	Minimum	Maximum	Mean	Std. Deviation
Temperature	18	25.00	32.00	27.6667	1.90973
pH	18	6.89	8.00	7.4911	.29309
Chloride	**18**	**140.00**	**1079.00**	**484.2222**	**356.71731**
Nitrite	18	.00	1.01	.4757	.34256
Nitrate	18	.49	8.08	1.6100	1.76107
Phosphate	18	.60	6.62	2.4106	1.50652
Silicate	18	22.50	48.16	31.5694	6.39272
Valid N (list wise)	18				

Temperature

The temperature plays an important role in the metabolic activities of the organisms and is considered as a biologically significant factor [7]. Water temperature during the study period was varying in the ranged from 25˚C to 32 ˚C. Variation in water temperature depends on the changing climatic conditions [8]. The temperature variation in hydrosphere results in characteristic patterns of water circulation, which greatly influence the aquatic life.

pH

pH was mostly remained alkaline throughout the study period at all the sites and fluctuated between 6.89 and 8.00. pH was statistically significantly negatively correlated at 1 % level of significance with chloride (Table II) which indicates that solubility of minerals and nutrients is influenced by the pH. pH of water is greatly dependent on the biological activity and temperature changes of the ambient atmosphere. The higher value of pH can also be attributed to increased production in aquatic ecosystem which utilize carbon and nitrogen from nitrates, and phosphorous, converting them into hydroxyl ions which increase the pH [9]. Changes in pH of water have direct bearing on the solubility and/or precipitation of certain metals in aquatic environment [10].

Chloride

From the Table II it was observed that Chloride showed strong negative correlation with pH and positive correlation with Silicate which reveals that dissolution of many nutrients depends upon the chloride content hence plays an important role in cycling of nutrients and minerals. Chloride ranged between 140-1079 mg/l during the study. The maximum level of chloride was 1079 mg/l at Site-1 during the month of October and November, 2012. From the descriptive statistical analysis (Table III) it was observed that among the site there was large variation in Chloride concentration which may be due to the discharge of sewage and industrial effluent. Chloride serves as an indication of sewage pollution [11]. Chloride in water influences salinity balance, ion exchange and is contributed by dissolution of salt deposits, sewage discharge, effluents from chemical industries and irrigation drainage to natural waters [12].

Silicate

The value of silicate ranged between 22.50-48.16 mg/l throughout the study. Silicate was statistically significantly positively correlated with chloride, nitrite and phosphate. The high levels of silicate in almost all the sites can be attributed to the sources of industrial pollution.

Phosphate

Phosphate was found between 0.60-6.62 mg/l during the study. It was positively correlated with silicate but no correlation with other parameters. High positive correlation between phosphate and silicate may cause rapid growth of phytoplankton, creating dense populations, or blooms result in eutrophication. Sewage is considered as the principle source of phosphate and other nutrients [13].

Nitrate and Nitrite

The amount of Nitrate and Nitrite were ranged from 0.49-8.08 mg/l and 0.00-1.01 mg/l respectively. Domestic sewage, natural run off and agricultural wastes are the important sources of nitrates in the aquatic ecosystem [14]. Nitrite and Nitrate are considered as an indicator of organic pollution of aquatic environments [12, 15]. It helps in the growth of algae resulting in eutrophication. High concentration of nitrite due to the addition of nitrogenous nutrients mainly terrestrial run off like break down of vegetation, use of chemical fertilizers in agriculture and oxidation of ammonia from nitrogen to nitrite [16].

IV. CONCLUSIONS

From the statistical analysis it is observed that some variables shows correlation with other variables which states that they are dependent to each other. Higher concentration of Silicate, phosphate and Chloride throughout the study period

reveals that water may be contaminated due to the industrial effluent, sewage waste water and other organic pollutants. The accumulation of these pollutants can be dangerous for both aquatic and human life. It is advisable to discharge treated waste water from industries and homes into the creek because these creeks ultimately get emptied into the marine or fresh water bodies. The significance of the study is data may be used to measure the extent of pollution in creeks so that some preventive action can be taken before the detailed investigation and controlled the pollution to a certain extent.

REFERENCES

[1]. Agarwal, A., and Saxena, M., (2011). Assessment of pollution by physicochemical water parameters using regression analysis: A case study of Gagan River at Moradabad- IndiaPelagia, Research Library Advances in Applied Science Research, 2 (2), pp. 185 - 189.

[2]. Sala, O.E., Chapin III, F.S., Armesto, J.J., Berlow, E., Bloomfield, J., Dirzo, R., Huber-Sanwald, E., Huenneke, L.F., Jackson, R.B., Kinzig, A., Leemans, R., Lodge, D.M., Mooney, H.A., Oesterheld, M., Poff, N.L., Sykes, M.T., Walker, B.H., Walker, M., and Wall, D.H., (2000). Global biodiversity scenarios for the year 2100, Science, 287, pp. 1770–1774.

[3]. Sudhira, H.S., and Kumar, V.S., (2000). Monitoring of lake water quality in Mysore City, In: Ramachandra T.V., Rajasekara M.C., and Ahalya N., Eds. Proceedings of Lake 2000, International Symposium on Restoration of Lakes and Wetlands 2000 , Bangalore, India, Centre for Ecological Sciences, Indian Institute of Science, pp. 1-10.

[4]. Adeyemo, O.K., (2003). Consequences of pollution and degradation of Nigerian aquatic environment on fisheries resources. The Environmentalist, 23(4), pp. 297-306.

[5]. APHA, (2005). Standard Method for the Examination of Water and Wastewater. 21st ed. New York.

[6]. Indian Standard – 3025. Part-34, 1988.

[7]. Varunprasath, K., and Daniel, A. N., (2010). Comparison Studies of three freshwater Rivers (Cauvery, Bhavani and Noyyal) in Tamil Nadu, India, Iran. J. Energy and Environ., 1 (4), pp. 315-320.

[8]. Parihar, S.S., Kumar, A., Kumar, A., Gupta, R.N., Pathak, M., Shrivastav, A., and Pandey, A.C., (2012). Physico-Chemical and Microbiological Analysis of Underground Water in and Around Gwalior City, MP, India, Res.J.Recent Sci, 1(6), pp. 62-65.

[9]. Zafar, A. R., (1964). On the ecology of algae in certain fish ponds of Hyderabad, India, Distribution of unicellular and colonial forms Hydrobiology, 24, pp. 556-566.

[10]. Campbell, P.G., and Stressier, A., (1985). Metal specification in natural waters, Influence of environmental acidification in sources and fates of aquatic pollutants, 7th ed., Washington D.C., Hites, R.A., and Elsenreich, S.J., American chem. Soc., pp. 185-207.

[11]. Gupta, N., Verma V.K., and Gupta, D.K., (2006). Pollution impact on hydrobiology of river Nakatia at Bareilly, In: Ecology of polluted waters, New Delhi.110035, Daya publishing House, pp. 82-90.

[12]. Kumar, A., (2002). Ecology of polluted water. vol. 2, New Delhi, A.P.H. Publishing Corporation.

[13]. Edmondson, W.T., (1972). Water quality management and Lake Eutrophication, Water resources management and public policy, pp. 139-178.

[14]. Saxena, M. M., (1987). Environmental Analysis of Water, Soil and Air, Agrobotanical Publisher (India), pp. 22.

[15]. Trivedy R. K., and Goel, P. K., (1990). Chemical and biological methods for water pollution studies, India: Environmental publications, pp. 248.

[16]. Govindasamy, C., Sundramoorthy, M., and Kannan, L., (2007). Impact of municipal wastes on the river water quality of river palar, Vellore, Tamilnadu, Indian Hydrobiology, 10 (2), pp. 349-357.