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Physico-chemical Analysis of Wetlands in Madhubani District, Bihar

ANAMIKA
Department of Chemistry, M.M. College, Patna-800 006, India
E-mail: anni_a@rediffmail.com

In this paper, physico-chemical parameters of wetland water analysis were carried out from various sampling station of Madhubani District, Bihar during the rainy and winter season for the year 2003-2005.

Key Words: Wetlands, Water body, Ecosystem, Biological, Physico-chemical parameters.

INTRODUCTION

Wetlands are the area where water covers the soil or is present either at or near the surface of soil throughout the year or for varying period of time during the year, including during the growing season. Two-thirds of the earth is surrounded by water and appears blue (the planet of water) from space[1]. Wetlands are estimated to occupy nearly 6.4 % of the earth's surface. The amount of fresh water on earth is very small in comparison to seawater.

The State of Bihar is very rich in natural and man-made wetlands and are used for irrigation, drinking, bathing and also for hydroelectricity purposes. Physico-chemical characteristic of water is responsible for changing the chemical form of materials and also in the spatial movement of material within wetland. It is essential to know the physico-chemical characteristic of water because the transportation and transformation of chemicals in wetlands involve a great number of interrelated physical and chemical as well as biological processes[2]. The unique and hydrologic condition in wetlands is markedly influenced by physico-chemical characteristic of water. Seasonal variation is also a important aspect.

EXPERIMENTAL

All chemicals used were of pure analytical grade as required. Glass bottles were used for the collection of water samples of wetlands with necessary precautions[3]. These samples were collected in and around Madhubani. Double distilled water was used for the preparation of reagents and solutions. Their major water quality parameters considered[4] for the examination in this study are temperature, transparency, pH, dissolved

oxygen, hardness, CO_3^{2-}, HCO_3^-, Cl^-, PO_4^{3-}, Na^+, K^+, Ca^{2+}, N and biochemical oxygen demand. Water samples were analyzed as per standard method.

RESULTS AND DISCUSSION

Various physico-chemical parameters of water was analyzed in rainy and winter season in the selected wetlands of Madhubani, Bihar during 2003-2005. The analytical results of various wetlands water have been shown in Table-1.

Water temperature is most important for all metabolic and physiological activities and life process of aquatic organism. Water quality is maintained by temperature. During the present investigations the water temperature ranged from 17.6 to 29.3 °C. Highest temperature was attained during the rainy season at station-2.

The pH value of wetland water is an important index of acidity, alkalinity and resulting value of the acidic-basic interaction of a number of its mineral and organic components. In the present study pH ranged from 7.3 to 8.5. It is apparent from the data of pH that the water is always associated with some kind of alkalinity[5].

Electric conductivity is directly related to total dissolved solids. In present study the electrical conductivity was ranged between 0.21 to 0.7 m mhos/cm. Electric conductivity found to increase during the rainy and winter season at station-2 having maximum values that gives a proof of mineralization.

Alkalinity is the presence of different ions of carbonate, bicarbonate, hydroxyl and free CO_2. Alkalinity measurement is an important factor for water quality and water treatment process. Wetland waters are rich in carbonates and bicarbonates. Alkalinity due to naturally occurring compounds like calcium carbonate is safe for consumption[6]. Alkalinity in itself is not harmful to human beings, still the water with less than 100 mg/L are desirable for domestic use[7]. In present study, carbonate ranged from 0.8 to 8.6 ppm while bicarbonate ranged from 200 to 294 ppm.

The presence of dissolved oxygen is most important water quality parameter. Presence of aquatic organism depends on the presence of oxygen. In aquatic bodies, oxygen comes either from air by slow diffusion or from photosynthesis of algae. In present study, the dissolved oxygen varied from 4.5 to 7.8 ppm. Average winter value was much higher than the rainy season value at all station during the whole study period. The most important limnological factor is dissolved oxygen, which gives a comprehensive picture of the nature and extent of pollution at any place. It is generally believed that the maximum dissolved oxygen for maintaining fish in a healthy condition is 50 mg/L at 20 °C (*i.e.* nearly 50 % of oxygen saturation) the critical value being 3 mg/L (about 30 % of oxygen saturation). About a minimum of 40 % of dissolved oxygen saturation is essential for fish life[8].

TABLE-1
PHYSICO-CHEMICAL CHARACTERISTIC OF WATER RECORDED AT RAINY AND WINTER SEASON (JULY 2003-JUNE 2005)

Parameters	Sampling station-1		Sampling station-2		Sampling station-3		Sampling station-4	
	Rainy season	Winter season	Rainy season	Winter season	Rainy season	Winter season	Rainy season	Winter season
Temperature (ºC)	26.4	17.6	29.3	19.6	29.0	18.9	27.5	19.0
Transparency (cm)	19.0	22.0	20.0	24.0	20.0	23.0	19.0	23.5
pH	7.8	7.3	8.5	8.5	7.9	7.5	7.8	7.3
Elec. Conductivity (m mhos/cm)	0.33	0.21	0.7	0.7	0.34	0.21	0.27	0.5
HCO_3^- (ppm)	290.0	210.0	250.0	229.0	280.0	200.0	294.0	228.0
CO_3^{2-} (ppm)	6.2	0.8	8.6	4.0	4.4	1.2	8.8	0.8
Dissolved oxygen (ppm)	4.6	7.4	4.5	7.4	4.9	7.8	4.8	7.6
Free CO_2 (ppm)	18.6	4.0	10.0	4.0	11.2	6.0	10.8	4.2
Hardness (ppm)	320.0	262.0	310.0	200.0	306.0	226.0	312.0	184.0
Ca^{2+} (ppm)	62.5	43.3	70.5	43.3	65.7	41.7	62.5	38.5
Mg^{2+} (ppm)	37.6	37.6	32.7	22.4	34.6	29.7	38.0	21.4
Cl^- (ppm)	31.2	15.6	24.1	14.2	36.9	14.2	32.7	21.3
Na^+ (ppm)	22.0	12.0	20.0	17.3	24.0	18.3	22.4	16.0
Nitrogen (ppm)	2.94	2.21	3.7	1.65	2.86	2.38	2.67	1.80
K^+ (ppm)	10.4	16.7	12.8	18.2	11.2	18.2	10.3	17.0
PO_4^{3-} (ppm)	0.06	0.02	0.04	0.02	0.08	0.05	0.07	0.2
Biochemical oxygen demand (ppm)	1.8	0.71	1.9	0.7	2.0	1.2	1.5	1.1

In general, waters with hardness less than 120 mg/L as $CaCO_3$ are desirable. In ICMR standards a desirable limits for this parameters has been set at 300 mg/L but waters with hardness up to 600 mg/L are allowed. Hardness varied between 184 to 320 ppm. Most of the samples of all the stations at rainy season exceed the prescribed limits set by WHO. Hardness does not have any ill impact on human health though some evidences have been given to indicate its role in heart diseases[9].

Limits for maximum concentration of Cl^- have been set on the basis of taste preferences. However, large amounts of Cl^- when Ca^{2+} and Mg^{2+} are also present, lead to increase in water's corrosiveness and may adversely affect the water quality by acquiring harmful elements. Main source of Cl^- is the discharge of domestic sewage. It is harmless up to 1500 mg/L. The rainy season value was higher than winter season value.

The Na^+ content of water was ranged from 12 ppm (winter) to 24 ppm (rainy). At low concentration, it has no adverse effect on health but high concentration of Na^+ causes the cardiovascular diseases[10].

In present study, nitrogen content was varied from 1.65 to 3.7 %. The maximum concentration of total nitrogen is in rainy season due to oxidation of organic matter present in water. Higher concentration of nitrogen is harmful to fish, other biota and man[11].

Study of result shows that the higher concentration *viz.*, 18.2 ppm of K^+ was observed at sampling station-2 and 3 in winter seasons, which is still below the harmful limits. K^+ is not of much concern from health point of view, but its large quantities may be laxative.

The concentration of PO_4^{3-} ranges 0.02 to 0.08 ppm. PO_4^{3-} is not harmful to man but in association with high value of Ca^{2+} may cause kidney stone.

In present study, the peak value of biochemical oxygen demand occurred during rainy season at all station which may be attributed to the rapid decomposition of organic matter due to flood water and ultimately demanding more supply of oxygen[12].

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