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Physico-Chemical Analysis of Water from Harahi and Gangasagar Ponds Located in Darbhanga District

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Abstract **Original Research Article**

The various sources are generating a lot of polluting materials in the ponds water of Harahi & Gangasagar in the district of Darbhanga in Bihar. The sources are domestic drainagesthat directly discharge night soil from houses, medical wastes from doctor's clinic as well as industrial garbage. It is due to the presence of houses, clinics, some industries near the Harahi and Gangasagar ponds. These wastes are very dangerous and hazardous in nature on one hand, and at the other hand may contain a lot of valuable materials which protect our environment. In view of safety, it is essential to treat these wastes properly to protect the environment. There are various ways by which toxic and valuable by-products can be separated. The toxic products can be properly discarded and valuable products can be effectively utilized. The authors present the physicochemical analysis of Harahi and Gangasagarpond water. The results obtained have been compared with standard values of "Bureau of Indian standard permissible limit for drinking water."

Keywords: Pollution, physico-chemical analysis, domestic drainage, industrial effluents, pharmaceutical wastes, toxic and hazardous.

INTRODUCTION

Darbhanga is one of the fastest growing cities in Bihar with rapid development and exploding population resulting in urbanization [1]. As result of population explosion pollution is the biggest problem in this city.

Pollution produced by people in turn affects them that make it a serious social problem [2]. Pollution production has two facts. One is the inevitable by production which is governed by natural laws. It therefore, cannot be stopped or cured without reducing the population [3]. By-product accumulation can be altered somewhat although it is debatable whether treatment measures would be significant without decreasing population growth. This type of pollution will be referred to as first order pollution.

The second fact will be referred to as the second order pollution or waste accumulation and implies waste that is formed as a result of man's technological activities. The amount of secondary waste is also directly related to the population size.

Pure water is not found in nature. Even rain water which is in fact distilled water, collect impurities such as dust, gases, bacteria etc. during its passage through atmosphere. Thus it has to be analysed in order to ascertain its quality.

Pollution may be natural or artificial. The artificial pollution forms the major part andis caused as a result of manmade activities. Artificial pollution is mainly caused by wastes from households, industries and agriculture lands. The domestic wastes include human excreta, urine, kitchen, washing and laundry wastes which do not receive any treatment and are directly discharged into reservoirs or water course. The above said problem is particularly significantin small town like Darbhanga which are situated close to flowing ponds and have poor sewer facilities. Darbhanga is locally considered as a town of ponds with many ponds available in and around the whole town. Nearly dozens of ponds are situated in this town. Additionally, there is no doubtthat several diseases in men and animals are obtained from waste water from corporations, municipalities, slaughtering plants and boats sanatoria etc.

Several diseases in humans like cholera and typhoid spread by polluted water. Dr John in 1850, reported that cholera epidemic were the result of some micro-organism present in the faces of cholera victim [4]. A study was carried out in the Ipswich and Shawsheen river basin in order to find out a relation between the number of septic tank disposal system in the drainage basins and few parameters describing the water quality of the drainage [5]. The results showed that the amount of dissolved solids in the basic flow of stream was depended on housing density [6].

The present study is a comparative account of the quality of water at Harahi and Gangasagar ponds of Darbhangatown in three different seasons namely summer, winter and rainy season.

The average of the three values thus obtained was taken into study.

MATERIALS AND METHODS

Collection of samples

The samples were collected from Harahi&Gangasagar ponds and labelled as inlet of waste water into ponds (S_1H, S_1G), outlet of waste water (S_2H, S_2G) and mid pond (S_3H, S_3G), hand pump near ponds (S_4H, S_4G), drinking water from industrial area (S_5H, S_5G), industrial waste water like Aluminium-factory (S_6H, S_6G) and pharmaceutical company or wastes flowing in ponds (S_7H, S_7G).

Sampling of water

Five-litre capacity plastic containers with lid were taken for the collection of water samples. These containers were washed with (1:1) HCL by dipping for 24 hours. Then thoroughly cleaned with tap water and finally with distilled water. The containers were not opened before the time of filling. At the sampling sites, the containers were first rinsed with sample water and then the samples were taken from the designated site i.e. the middle or banks of ponds and at the depth of ten inches below the surface of water. These water samples from ponds, tube well and other selected sites were collected in all the three seasons winter, summer and rainy.

The samples were taken by holding containers in the hand near its base and plunging its neck downward below the surface. The containers were turned until the neck points slightly upward, the mouth being directed against the current 500 to 600 ml samples were taken in each container and which were later labelled immediately with complete details. The samples were preserved by adding 2 ml conc.H_2SO_4 per litre. The time and temperature of the selected sites were noted. For the analysis of oil and grease, the samples were taken in wide mouthed saline bottles.

Analysis

The collected samples were analysedfor different parameters soonafter collection. The parameters tested included pH, turbidity, electrical conductivity (EC), total dissolved solids (TDS), alkalinity, total hardness, dissolved oxygen (DO), biological oxygen demand (BOD) and chemical oxygen demand (COD). The concentration of different ions like calcium, magnesium, potassium, sodium, iron, sulphates, fluoride, chloride and phosphates (total and dissolved) was also analysed in the representative samples**.** Standard methods recommended by APHA (2005) were followed for the analyses.

The results were tabulated in Table 1, 2 & 3. The results have been compared with the values given by the standard values for drinking watersuggested in the Bureau of Indian standard (BIS 1991).

RESULTS

The pound water is largely influenced by pollution particularly in urban cities. It has large effect on physical and chemical properties of water. Many biotic and abiotic component of ecosystem are changed. The physical characteristics of turbidity, TDS (mg/L), electrical conductivity (mho/cm) and pH was studied from 7 sites of Ganga Sagar and Harahi pounds of Darbhanga district (Table 1).

The chemical reactions studied in pond water included alkalinity (mg/L), total hardness (mg/L) oil and grease (mg/L) dissolved oxygen (DO) of water in mg/L , chemical oxygen demand (COD) of water in mg/L and biological oxygen demand (BOD) of water in mg/L (Table 2).

The concentration of cations/anions including calcium, magnesium, sodium, potassium, iron, fluoride, chloride, sulphates, total phosphates, dissolved phosphates were studied (Table 3).

Table 1: Physical parameters for drinking water, ponds water and Industrial effluents during rainy season

Parameters	S_1H	S_1G	S_2H	S_2G	S_3H	S_3G	S_4H	S_4G	S_5H	S_5G	S_6H	S_6G	S_7H	S_7G	Desirable Limits	Permissible Limits
Turbidity	46	47	55	55	52	53	4	3.5	3	2.5	14	14	25	25	5.0	10.0
Electrical Conductivity in mho/cm	1254	1253	1174	1176	887	856	1244	1245	767	765	1455	1460	1755	1756	50-800	>800
Total dissolved solid (TDS) mg/L	2482	2491	2567	2565	2748	2756	2654	2660	856	858	879	880	1255	1260	300	600
pH	6.1	6.4	6.9	6.87	6.3	6.35	6.20	6.24	6.73	6.71	8.4	8.7	6.24	6.24	6.6-8.5	No relaxation

Table 2: Chemical parameter for drinking water, ponds water and industrial effluents during rainy season

Parameters	S_1H	S_1G	S_2H	S_2G	S_3H	S_3G	S_4H	S_4G	S_5H	S_5G	S_6H	S_6G	S_7H	S_7G	Desirable Limits	Permissible Limits
Alkalinity mg/L	544	556	500	510	356	367	452	455	298	292	267	270	136	132	200	600
Total Hardness mg/L	654	652	744	746	544	545	611	612	454	450	382	385	554	552	300	600
Oil & Grease	118	120	162	162	166	166	154	155	110	112	170	172	180	182	-	-
DO mg/L	Nil		Nil		Nil		7.2	7.4	5	4.5	8	8	Nil		10	Not less than 10
COD mg/L	75	75	60	60	67	67	74	73	67	66	92	94	121	124	-	250 Inland or Surface water
BOD mg/L	108	112	117	115	114	115	114	118	116	115	122	121	128	126	5	5
TC (MPN/100ml)	-	-	-	-	2400	2200	440	435	34	30	-	-	-	-	-	-
FC (MPN/100ml)	-	-	-	-	1400	1200	160	110	8	7	-	-	-	-	-	-

Table 3: Concentration of cations/anions in drinking water ponds (Harahi & Ganga Sagar) and industrial effluents in mg/L during rainy season

Parameters	S_1H	S_1G	S_2H	S_2G	S_3H	S_3G	S_4H	S_4G	S_5H	S_5G	S_6H	S_6G	S_7H	S_7G	Desirable Limits	Permissible Limits
Calcium	87	86	92	91	66	64	70	72	80	85	56	54	98	97	75	200
Magnesium	45	47	54	55	47	40	42.5	43.6	34.2	36	21	22	46	45	30	100
Sodium	35	38	31	30	26	27	35	34	28	27	58	56	18	20	-	-
Potassium	24.5	26	25.2	27	18.4	19	22.1	23.2	26	25	1.2	1.3	6.4	6.2	-	-
Iron	1.3	1.2	2.1	2.4	1.32	1.4	2.4	3.2	4.2	4.5	1.2	2.1	1.3	2	0.3	1.0
Fluoride	1.12	1.20	1.20	1.24	2.73	2.75	0.46	0.48	0.98	0.98	1.62	1.60	1.52	1.54	1	1.5
Chloride	78	77	42	46	92	90	116	115	18	18	16	15	19	18	250	1000
Sulphate	0.42	0.44	0.52	0.54	0.32	0.30	0.45	0.44	0.21	0.22	0.46	0.45	0.38	0.34	200	400
Total phosphate	1.2	1.10	0.28	0.30	0.78	0.80	0.42	0.44	0.20	0.22	0.32	0.32	0.78	0.78	-	-
Dissolved Phosphate	0.60	0.62	0.20	0.21	0.24	0.24	0.16	0.16	0.12	0.12	0.18	0.18	0.28	0.28	-	-

DISCUSSION

In our study the maximum turbidity was noted at sampling sites S_2H and S_2G of 55 each. The minimum turbidity was noted at S_4H of 4. Turbidity of pond water varies from almost zero to highly turbid, depending on the amount of suspended particles. High turbidity makes pond water unsuitable for acquatic life [7].

The maximum electrical conductivity (mho/cm) was noted at sampling site S_7G and minimum at S_5G with values1756 and 765 of respectively in this study. Water becomes a conductor of electric current due to substances are dissolved in it and its conductivity is proportionate to the amount of the substances dissolved in it [8]. The conductivity of these substances depends on their charges.Conductivity measurement is useful in monitoring the total salt level in pure water supply line, in river, lakes and ponds and effluent discharge channels [9].

The maximum pH was noted atS_6G and minimum at S_1H with 8.7 and 6.1 of respectively. pH effect bacteria and decomposition in a pond. Most useful bacteria cannot survive overly acidic water. Moreover, high pH may also increase the toxicity of other substances.

The sum of all the chemical ions dissolved in the water is called total dissolved solids or TDS [10]. TDS is controlled by the natural source of pond water and by nearby land use activities. The highest TDS of pond water was noted at S_3G (2756 mg/dl) and minimum at S_5H of 856 mg/dl.

In our study it was found that alkalinity of water was maximum at S_1G i.e. 556 mg/L while it was minimum at S_7G i.e. 132 mg/L. The main source of alkalinity of water are carbonate, bicarbonate and hydroxide compounds.The alkalinity of water on one hand may act as buffer and on the other hand high alkalinity may lead to gastrointestinal problems and skin irritation.

The maximum biochemical oxygen demand (BOD) of the sample was observed at sites S_7H (128 mg/dl). BOD is a good index of pollution and therefore helps in deciding the suitability of water for consumption [11].

The COD of water means amount of oxygen required to oxidise organic matter. It is indicator for sewage and water pollution. The maximum value of COD varied from 64.07 mg/l to 86.70 mg/l and the maximum value was observed at S_6G (94 mg/dl). Total hardness of pond water was found maximum at site S_2G 746.0 mg/l.

Dissolved oxygen (DO) is an important parameter of water quality which reflects physical and biological processes taking place in water. High level of DO causes speed up corrosion in water pipes levels lower than 10 mg/ dl are not permissible for human use.The low value of DO may be due to pollution load, organic matter and photosynthetic activity.The total coliform (TC) and total coliform (FC) were also reported at few sites. The similar findings were studied by Sinha D, Arya S *et al.*, at their independent studies [12, 13].

In our study calcium was minimum at S_6G 54 mg/dl and magnesium at S_6H 21 mg/dl. Lowest sodium was recorded atS_7H 18 mg/dl and highest at S_6H 58 mg/dl. Potassium was highest atS_2G 27 mg/dland lowest at S_6H 1.2 mg/dl. Iron ranged from 1.2-4.5 mg/dl.Our results were concordant with the studies by Bhagat P, Bhuiyan J *et al.*, [14, 15].

CONCLUSION

It is finally concluded on the basis of above results and discussions that the water of Harahi and Ganga Sagarponds is not suitable for the human consumption. It is very much feared that this contaminates the ground water which is fatal for the public health and environment.

Conflict of Interest: The authors have no conflicts of interest regarding this investigation.

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