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RESEARCH ARTICLE

ASSESSMENT OF THE WATER QUALITY STANDARD OF BRAHMANI RIVER IN TERMS OF PHYSICO-CHEMICAL PARAMETERS

***,[1]Himanshu Sekhar Rath, [1]Somen Das [2]Debasis Panda, [1]Dash U. N. and [1]Mira Das**

[1]Department of Chemistry, SOA University, Bhubaneswar, 751030, India
[2]Department of Veterinary Physiology, OUAT, Bhubaneswar, 751003, India

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ABSTRACT

The present investigation is aimed at assessing the current water quality standard along the stretch of Brahmani river in terms of physico-chemical parameters. In the selected study area the River Brahmani is receiving a considerable amount of industrial wastes and witnessing a considerable amount of human and agricultural activities. Nine samples were collected along the entire stretches of the river basin during the period from June-2013 to May-2014 on the first working day of every month. Various physico-chemical parameters like pH,, EC, Total Hardness, Total alkalinity sodium, potassium, calcium, magnessium, nitrate sulphate D.O.,B.O.D. etc. were analysed. The present study indicates that the water quality of Brahmani River is well within tolerance limit taking the physico-chemical parameters in to considerations.

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INTRODUCTION

As water is the basic need of the habitants, its safeness must be studied before use. The present study aims at detecting the quality of water across the Brahmani River in respect of physico-chemical and bacteriological parameters. Although in rural areas of developing countries, the great majority of water quality problems are related to bacteriological and other biological contaminations, a significant number of very serious problems may also occur as a result of physico-chemical impairity of water resources (Iqbal and Katariya, 1995). With rapid industrialization and urbanization, the river water pollution is increasing rapidly. Effect of poor water quality on human health was noted for the first time in 1854 by John Snow, when he traced the out break of cholera epidemic in London to the Thames river water which was grossly polluted with raw sewage. Since then the science of water quality monitoring progressed. In the third world countries 80% of all diseases are directly related to poor drinking water and insanitary conditions.

****Corresponding author: Himanshu Sekhar Rath***
Department of Chemistry, SOA University, Bhubaneswar, 751030, India.

As water is one of the most basic needs of the habitants, its safeness must be studied before use. The physico-chemical quality of river water is very important from the health point of view. Thus, constant monitoring of river water quality is needed so as to record any alteration in quality and outbreak of health disorders. The present study reports on the river water quality of fourteen different stations of Brahmani basin as given below. The present study aims at detecting the quality of water in respect of physico_chemical parameters Studies. The possible number of such parameters necessary to completely specify the quality of water is very large. However at present fourteen parameters are considered to characterize the Brahmani River water.

Study Area

The River Brahmani, the second largest river of Odisha is one of the major peninsular river systems in India. The confluence of the rivers Koel and Sankh at Vedvyasa near Rourkela in the district of Sundargarh gives rise to the river Brahmani. It travels southward through the districts of Sundargarh, Deogarh, Angul, Dhenkanal, Jajpur, and Kendrapara finally flowing into Bay of Bengal. After Kabatabandha, it divides into two rivers namely Brahmani and Kharasrota (Kharasuan).

The major flow of water goes into Kharasrota. After covering a few kilometres, the river Birupa joins Brahmani and it flows onwards in the name of Brahmani though its major portion of water comes from the river Birupa. The study area covers 9 major sampling points covering Sankh at Tilga, Koel at Jareikela and Brahmani river from its origin at Vedavyasa near Panposh up to Jenapur. In this stretch, the river Brahmani is joined by several drains and streams carrying industrial effluents, city wastages, mining residues etc. along with a number of tributaries. KabatabandhaJenapur is the last sampling point. The sampling stations are selected mainly.

MATERIALS AND METHODS

Water samples were collected every month, from June 2013 to May 2014 from nine different stations as mentioned in the above table, in clean and dry polythene bottles. The water samples were collected and preserved for testing of various parameters at 10^{o} C throughout the period of chemical analysis. The water samples were analysed in the Chemical Laboratory, Department of Chemistry, ITER, SOA University, Bhubaneswar using standard methods (APHA 2005). The pH and Dissolved Oxygen of water samples were measured immediately after sampling at the field itself. Samples were subjected to filtration before chemical analysis. The determination of TDS was done by gravimetric process while the total hardness was carried out by EDTA complexometric titration method (APHA 2005).The Winkler's alkali iodide-azide method was followed for the estimation of DO and BOD. Nitrate was determined colorimetric procedure (APHA 2005) (Singh *et al*., 1998). Faecal coliform population was analysed by MPN /100 ml method by growing on M-FC medium at temperature 44.5^{0} C and counted after 48 hours.

RESULTS AND DISCUSSION

Temperature is an important factor to influence the physico-chemical parameters and the biological reaction in water. Higher values of temperature accelerate the chemical reaction and reduce the solubility of gases and DO. In the present study temperature varied from 22^{o}C to 35^{o}C.

pH Level

The pH of most raw water sources lies within the range of 6.5-8.5 (Henery and Heinke, 2005). All the 108 water samples are found to have pH value well within the tolerance limit. The pH value ranges from 6.5 to 8.4. Panposh recorded the maximum pH value 8.4 and Gomlai the minimum pH value 6.5

Electrical conductivity

Pure water is a poor conductor of electricity. Presence of acids, bases and salts in water make it relatively good conductor of electricity. With increased air pollution, the acid rain also adds to the conductivity of surface water. Greater is the conductivity greater anions and cations in the water and greater is the dissolved matter (electrolyte) in it. Electrical conductivity is used as a basic index in judging the suitability of water for potable properties. Present studies revealed that all the samples recorded conductivity values well within the tolerance limit prescribed by ICMR and WHO. Tarkera (R.S.P.) recorded te highest conductivity value 610 µ mho/cm. It may be due to the impact of Rourkela Steel Plant Effluent. The minimum conductivity value 84 µ mho/cm is recorded at Tilga. Tolerance limit for conductivity in drinking water is 2300 µ mho/cm

Total hardness

Water hardness is the traditional measure of capacity of water to react with soap, hard water requiring a considerable amount of soap to produce lather. Scaling of hot water pipes, boilers and other household appliances is due to hard water. In fresh water, the principal hardness causing ions are calcium and magnesium; the ions strontium, iron, barium and manganese also contribute to some extent. It is expressed as an equivalent concentration of calcium carbonate. The permissible limit of hardness as calcium carbonate is 300 mg/l. Our investigation shows all the water samples are much below the permissible limit. The total hardness is considered taking presence of calcium and magnesium ion in water samples. Its permissible limit is 75 to 200 mg/l. Maximum value was recorded at Tarkera and minimum value at Gomlai.

Total alkalinity

Alkalinity is not a pollutant. It is a total measure of the substances in water that have acid nutralising capacity. Alkalinity indicates the power of a solution to react with acid and buffer its pH, that is the power to restrict its pH from changing (Webber and Stamm, 1963). It is due to salts of weak acids and bicarbonates and is estimated in terms of an equivalent amount of calcium carbonate. No permissive and excessive values of total alkalinity are given by WHO, ISI and ICMR (Rockville *et al.,* 1962) But according to USPHS, the value of total alkalinity as $CaCO_3$ is 120 mg/l. The average value of total alkalinity in the different sources of water samples of the present observation ranges from 40.00 at Tilga to 84.00 mg/l at Kamalanga. It indicates that the river water has better buffering capacity going down of the stream and is important for fish and aquatic life. It is also less vulnerable to acid rain. The alkalinity has no known adverse effect on health, some evidence has been given to indicate its role in heart disease (Trivedy, 1984).

Total Dissolved Solids

Total dissolved solid at a given temperature is the material residue left in the vessel after evaporation of a filtered sample and subsequent drying in an oven. TDS contains different kinds of nutrients and have been proved to be a very useful parameter. A sudden rise in TDS content can often indicate pollution by an extraneous source. Excess amount of TDS may disturb ecological balance and causes imbalance in osmotic regulation and suffocation in aquatic fauna even in presence of fair amount of dissolved oxygen (Webber and Stamm, 1963). Water containing more than 500 mg/l of TDS is not considered desirable for drinking water supply and normaly less palatable and may induce an unfavourable physiological reaction in the transient consumer. In the present investigation, it is seen that TDS value of most of the water samples are well within the permissible limit except at Jareikela.

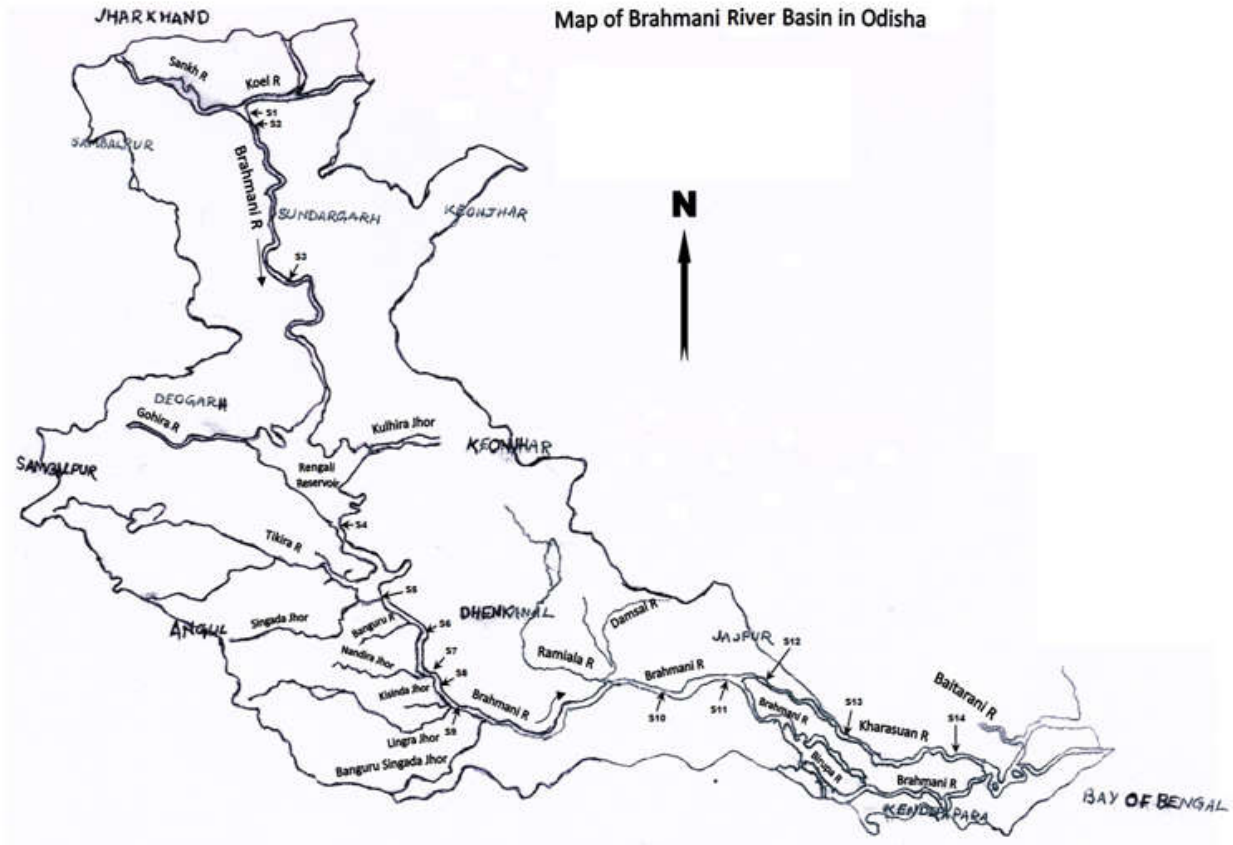

Table 1.

Sample Code	Name of the station	River/ Tributary	State	District	Description of the location
S_1	Tiga	Sankh	Jharkhand	Simdega	Upstream of Panposh
S_2	Jaraikela	Koel	Odisha		Upstream of Panposh
S_3	Panposh	Brahmani	Odisha	Sundergarh	Confluence of Koel and Snkh to form Brahmani
S_4	Tarkera (R S P)	Brahmani	Odisha	do	Mixing point of Rourkela Steel Plant Effluent with Brahmani
S_5	Gomlai	Brahmani	Odisha	do	About 50 km downstream of Rorkela
S_6	Talcher	Brahmani	Odisha	do	About 5 km upstream of the Nalco effluent confluence with Brahmani
S_7	Nandira	Brahmani	Odisha	do	confluence of Nalco effluent with Brahmani
S_8	Kamalanga	Brahmani	Odisha	do	1.5 km downstream of the confluence of Nalco effluent with Brahmani
S_9	Jenapur	Brahmani	Odisha	Jajpur	Before the bifurcation of Brahmani to form Kharasrota

Table 2.

Name of the Sampling Station	pH			Conductivity in μ mho/cm			Sulphate(SO_4^{--}) in mg/l		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
Tilga-S_1	7.9	7.3	7.6	126	84	104	37.1	1.3	9.4
Jareikela-S_2	8.0	7.2	7.6	330	157	222	36.2	1.2	8.3
Panposh-S_3	8.4	7.0	7.5	250	132	191	49.0	1.0	17.1
R.S.P.-S_4	8.2	6.5	7.5	610	260	375	59.2	24.6	44.2
Gomlai-S_5	8.0	6.8	7.6	280	102	196	53.0	4.1	19.8
Talcher-S_6	8.0	7.1	7.6	171	105	137	198.7	2.8	27.1
Nandira-S_7	7.8	7.3	7.5	490	132	310	78.4	15.0	43.1
Kamalanga-S_8	7.9	7.2	7.6	470	125	281	204.8	13.8	53.2
Jenapur-S_9	7.9	7.0	7.6	190	120	142	56.8	3.2	14.9

Table 3.

Name of the Sampling Station	Nitrate(NO_3^-) in mg/L			Chloride(Cl^-) in mg/L			Bicarbonate(HCO_3^-) in mg/L		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
Tilga-S_1	0.84	0.70	0.73	21.4	9.4	14.9	90	23	40
Jareikela-S_2	9.53	0.78	2.64	30.2	11.3	19.9	107	11	66
Panposh-S_3	0.71	0.70	0.71	22.6	11.3	16.2	102	28	75
R.S.P.-S_4	1.22	0.76	1.07	50.9	22.6	33.7	209	11	77
Gomlai-S_5	0.71	0.21	0.66	34.0	11.3	17.6	113	39	73
Talcher-S_6	0.71	0.70	0.71	34.0	9.4	16.2	124	34	67
Nandira-S_7	1.22	0.80	0.88	41.2	11.3	25.4	175	39	83
Kamalanga-S_8	9.63	0.73	1.56	34.0	11.3	22.2	135	34	84
Jenapur-S_9	0.71	0.70	0.71	18.9	9.4	13.2	141	34	62

Table 4.

Name of the Sampling Station	Calcium(Ca^{++}) in mg/L			Magnesium(Mg^{++}) in mg/L			Faecal Coliform MPN/100mL		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
Tilga-S_1	13	6	10	3.9	1.0	2.4	7000	320	1510
Jareikela-S_2	27	11	19	10.7	2.9	7.6	6300	110	1270
Panposh-S_3	30	6	19	10.7	1.0	5.6	19500	14200	18100
R.S.P.-S_4	42	14	30	26.2	1.9	11.4	18000	7300	9260
Gomlai-S_5	24	10	18	28.2	2.9	10.4	3200	180	1120
Talcher-S_6	53	10	20	14.6	3.9	7.3	7200	560	1740
Nandira-S_7	38	13	26	30.1	1.9	10.6	8300	1300	2230
Kamalanga-S_8	50	11	26	36.0	3.9	10.2	5840	1100	2120
Jenapur-S_9	34	14	18	38.9	1.9	10.4	6540	1040	1800

Table 5.

Name of the Sampling Station	Sodim(Na^+) in mg/L			Potassium(K^+) in mg/L			Total Solids		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
Tilga-S_1	16.3	1.4	5.8	2.4	1.1	1.6	303	140	197.8
Jareikela-S_2	15.3	2.4	8	8.1	1.4	3.7	594	250	392
Panposh-S_3	9.3	1.4	6	2.3	1.2	1.8	392	121	210.9
R.S.P.-S_4	23.0	2.8	13.5	8.0	1.4	5.1	410	100	160.5
Gomlai-S_5	12.1	3.0	7.5	3.0	1.6	2.2	350	116	177.7
Talcher-S_6	5.9	3.6	4.8	2.0	1.1	1.6	342	106	167
Nandira-S_7	24.3	5.1	14.5	6.4	1.6	3.1	348	132	260.3
Kamalanga-S_8	25.2	4.1	12.5	4.9	1.5	2.8	385	124	267.9
Jenapur-S_9	10.8	3.9	5.6	11.6	1.2	2.3	348	129	253.2

Table 6.

Name of the Sampling Station	D.O In mg/L			B.O.D in mg/L		
	Max	Min	Mean	Max	Min	Mean
Tilga-S_1	8.7	6.4	7.5	2.0	0.2	0.9
Jareikela-S_2	8.5	6.0	7	1.6	0.2	0.5
Panposh-S_3	10.5	5.0	6.9	1.4	0.2	0.6
R.S.P.-S_4	10.7	2.2	5.6	19.8	0.6	3.3
Gomlai-S_5	7.9	5.2	6.9	1.0	0.2	0.6
Talcher-S_6	8.5	6.0	7.5	2.0	0.2	0.8
Nandira-S_7	7.9	1.8	6.5	2.0	0.2	0.8
Kamalanga-S_8	8.5	4.6	7.1	1.8	0.1	0.8
Jenapur-S_9	7.9	6.2	7.1	1.4	0.2	0.6

The increased TDS value in the lower stretches of the river may be due to the salt water intrusion due to the proximity proximity to Bay of Bengal (Bhattacharya *et al.,* 2008).

Sodium and potassium

Sodium is the chief cation in the extra cellular fluid. About 50% of body sodium is present in the bone, 40% in the extra cellular fluid and the remaining (10%) in the soft tissues. Whereas potassium is the principal intracellular cation. It is equally important in the extra cellular fluid for specific function such as influencing cardiac muscle activity (Satyanarayan, 2004). According to European economic community the limit for sodium is 200mg/l and for potassium is 10mg/l of drinking water. The study reveals the mean value of sodium and potassium content in the water samples are well within the permissible limit along the entire stretch of Brahmani River.

Dissolved oxygen

Dissolved oxygen is one of the most important parameters of water quality assessment and reflects the physical and biological processes prevailing in the water and show metabolic balance. A high DO level in a river water sample is good because it makes the water better from drinking as well bathing point of view and friendly for aquatic lives. However, high DO levels speed up corrosion in water pipes. For diverse fish population the DO level must ranges from 4-9 mg/l. The river water of Brahmani is good fishing water. However, according to Europian Economic Community the standard value of DO is 5mg/l of drinking water. The average DO values of water samples from the river ranges from 6.5 mg/l to 7.5 mg/l (Table 5).

Biochemical oxygen demand

The degree of microbially mediated oxygen consumption in water is known as biochemical oxygen demand. This parameter is commonly measured by the quantity of oxygen utilized by suitable micro-organisms during 5 days period at 20^oC . It is not a pollutant but an indicator to what extent the water is polluted. Its value 6.0 mg/l or more in water body is said to be polluted. Present study reveals the mean value of BOD of the Brahmani River is 3.3 mg/l at Tarkera which is the highest average value whereas that of the remaining sampling stations ranges from from 0.19 mg/l to 0.9 mg/l. The BOD of Mahanadi, the biggest river of Odisha is of high mean value,

11.2 mg/l (Singh and Mohapatra,1998) at Mahanadi-Atharabanki and Mahanadi sea confluence (Pradyusa Samantaray *et al*., 2009). Thus, the Brahmani river water is less polluted from B.O.D. point of view. than Mahanadi.

Bacteriological parameter

Pathogenic bacteria present in water are responsible for causing water borne diseases like cholera, typhoid, dysentry (bacillary and amoebic) etc. The bacteriological analysis of water is essential to determine its potability for drinking. The bacteriological analysis carried out were most probable number (MPN) of total coliform and faecal coliform. Presence of coliform bacteria is undesirable for human consumption. Generally the coliform bacteria is observed in raw water samples. When the water comes in contact with sewage, coliform bacteria are observed. Occurrence of faecal coliform is more significant than total coliforms. According to WHO, E.Coliform should be absent and if coliform counts were found in no case it should exceed 10/100 ml (Guide lines for drinking water quality, 1984). The bacteriological analysis was done for all the samples during the year and found that the presence of Faecal Colliform was alarmingly high in Brahmani River particularly at Panposh. It is mainly due to the near by peoples defecate in open places along the river bank and other human activities across the river stretch is very high. The upper stretch of the river at Rourkela has a high MPN count, which is minimum at Rengali Samal stretch and again increases down stream.

Conclusion

The present study reveals that the water quality of Brahmani River is quite safe as compared to the physico-chemical parameters point of view at present. However due to increased industrial and human activities along its bank a constant monitoring of the water quality of the river is a must to maintain the river water quality.

Applications

The present study is usefl in ascertaining the water quality of Brahmani River along its entire stretch for its potability for industrial, agricultural and human use.

REFERENCES

Bhattacharya, A.K., Basack, S. and P. Maity, 2008. Saline water intrusion in Bhadrak and Balasore district of Orissa, India, EJGE, 13, 01-07.

Guide lines for drinking water quality, 1984, Vol-3 WHO, Geneva.

Henery G.J. and G.W. Heinke, 2005, Environmental Science Engineering (2nd Edition), Prentice Hall of India Pvt. Ltd., New Delhi.

Iqbal, S.A. and Katariya, H.C. 1995. Physico-chemical analysis and water quality assessment of upper lake of Bhopal. *Indian Journal of Environmental Protect*ion,15(7) 504-509.

Jr. W.J. Webber and W. Stamm, 1963. Mechanism of hydrogen ion buffering in natural bigojohi 102 water, *Journal of American Water Works Association*, 55 ; 1553.

Pradyusa Samantaray, Basant, K. Mishra, Chitta. R. Panda and Swoyam P. Rout, 2009. Assessment of water quality index in Mahanadi and Atharabanki rivers and Taladanda canal in Paradip area, India, *J. Hum. Ecol*., 26(3) 153-161.

Public Health Service Drinking Water Standards, 1962. Rockville, MD, US Department of Health, Education and Welfare, P-21 (Public Health Service Publication No. 956).

Satyanarayan, U. 2004. Biochemistry, Books and Allied (P) Ltd, P-455

Singh, B.C. and Mohapatra, U.K. 1998. Physico-chemical and Bacteriological Parameters in various sources of Drinking water in the old Capital City of Cuttack, *J.T.R. Chem.,* 5(1) 44-50.

Trivedy, R.K. Goel, 1984. Chemical and Biological methods for water pollution studies.

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