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PHYSICO-CHEMICAL ASSESSMENT OF POND WATER, MUNICIPAL SEWAGE AND INDUSTRIAL EFFLUENT OF RAJNANDGAON (CHHATTISGARH), INDIA

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Abstract: Rajnandgaon town is rich in water reservoirs. The town is situated around two large ponds and bank of Sheonath River. Without these reservoirs, we are not able to conceive of the survival and development of Rajnandgaon. Thus, the physic-chemical parameter of ponds, municipal sewage and industrial effluent were recorded during present work. The maximum value of these parameters was found as follows- temperature, 22.67±0.33; pH, 7.53±0.02; turbidity, 248.67±7.40; fluoride, 2.70±0.17 mg/l, nitrate, 2.36±0.16 mg/l; chloride, 53.33±3.33 mg/l; iron, 0.46±0.02 mg/l; hardness 553.33±13.02; arsenic, 0.05±0.02 mg/l; DO, 9.33±0.32 mg/l; BOD, 163±3.78 mg/l and COD 347±15.89 mg/l. The physic-chemical data is now helpful to know the pollution level of different source of Rajnandgaon as well as helpful to make an effective approach to control the water pollution.
Keywords: Water pollution, Rajnandgaon, Industrial waste water, Municipal sewage.

Introduction

The maximum quantity of water on earth belongs to salty in nature and only a few are freshwater. Freshwater is now confined to supply due to over exploitation and pollution by anthropogenic activity (Gupta and Shukla, 2006; Singh and Mathur, 2005). The physico-chemical attributes of water reservoir is affected by adding of pollutant releases from industrial, sewage, municipal discharge and agriculture practices (Dwivedi and Pandey, 2002). Discharge of domestic water has resulted in eutrophication in different reservoirs (Pandey and Pandey, 2003).

Rajnandgaon is one of the fastest developing towns of central India; it bears many small and medium industries belonging to paper, oil, broiler, rice mills, bakery etc. The monitoring and analysis of quality of effluent releases from these manufactures are not doing previously. Hence, the present study helps us to see the level of pollutants and also to aware the citizens. The Budhasagar and Ranisagar two large ponds are the primary draw of the Rajnandgaon town. A large population of the town is around these two pools. These pools are the source of

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bathing and washing of textiles by local people of Rajnandgaon. These two pools are also the sites of domestic waste disposal by illiterate people living around it increasing the layer of contamination.

Thus, the Rajnandgaon is facing a triple dose pollution in water reservoir; first the release of municipal water into the Sheonath river; second, pollution into two large pond Budhasagar and Ranisagar and third; toxic effluent discharges from industries. Thusly it is now a time to continuously supervising the environment of the town. Hence, the present study aims to study the level of pollutants from Budhasagar and Ranisagar pond, municipal sewage water and likewise to the industries working in and near of Rajnandgaon.

Materials and Methods

Study Area

The Rajnandgaon is the ethnic capital of Chhattisgarh state India. It is situated at 20.07" to 22.2"9 North latitude and 80.2 to 81.2"4 East longitudes. Ranisagar and Budhasagar Ponds are located in the heart of Rajnandoan town (Figure 1). The industries are located in and around of 10km of town. Sampling was done from two ponds, municipal sewage and industrial waste water of dairy, paper mill, rice mill and oil industry (Table 1).

Sample collection and Analysis of Physico-chemical parameter

The sample collection was performed on January 2015. In the rainy season precipitated water dissolved with industrial effluent and in summer season high temperature evaporates the effluent. Thus, the winter season is selected for the collection of waste water, which was not touched by such components. The collection of water samples was done according to Mahish *et al.,* (2015). In short, air tight prewashed sterile plastic bottles were used and analysis of was done within 06hr of collection. The dissolved water (DO), biochemical oxygen demand (BOD) and chemical oxygen demand (COD) was performed according to Mahish *et al*. (2014). The pH, turbidity, fluoride, nitrate, chloride, Iron, Hardness, was analyzed using Octa water testing (Develop by HiMedia). Arsenic was analyzed using Merkoquant (Develop by Merk, Germany).

Statistical Analysis

All observations were taken into triplicates. Mean and standard error of triplicate data was estimated. All computations and statistical work were done using Microsoft excel 10.

Table 1. Sample Collection sites in and around in Rajnandgaon town

S. No.	Sample collection site	Sample Type	Distance from laboratory	Geographical Location
1	Budhasagar	Pond water	0.0 Km.	21°5.638 N to 81°1.617 E
2	Ranisagar	Pond water	0.0 Km.	21°5.344 N to 81°1.588 E
3	Municipal sewage	Municipal waste water	0.5 Km.	21°5.311 N to 81°1.321 E
4	Dairy industry	Industrial effluent	06 Km.	21°3.549 N to 80°53.141 E
5	Paper industry	Industrial effluent	10 Km.	21°2.928 N to 80°57.118 E
6	Rice mill	Industrial effluent	04 Km.	21°5.704 N to 80°58.347 E
7	Oil Industry	Industrial effluent	08 Km.	21°5.784 N to 80°57.294 E

Figure 1: Location of Ranisagar and Budhasagar pond around Laboratory (Digvijay College)
Source: Google Earth

Results and Discussion

The physico-chemical parameter of pond water, municipal sewage and industrial waste water was recorded and findings are rendered here in different subheads. The findings are listed in table 2.

Temperature

In the present monitoring temperature of different water samples were recorded from 20.33±0.33 to 22.67±0.33°C. In a city of Chhattisgarh temperature of pond water was recorded from the range of 20.9 to 33.8°C (Dixit *et al*., 2015).

pH

Potential hydrogeni (pH) of a solution refer to hydrogen ion activity at a given temperature. It was found slightly acidic to basic in the present study. The acidic pH was recorded maximum 6.88±0.03 in Ranisagar while maximum basic pH was recorded from 7.53±0.02 in rice mill waste water. A broad range of pH was recorded from different pond investigated previously, from 5.81 to 8.55 in Santiniketan, West Bengal, India and 6.50 to 9.69 in Bilaspur, Chhattisgarh, India (Nag and Gupta, 2014 and Dixit *et al*., 2015). In the municipal sewage, pH was recorded from 7.16±0.06 in the present work. Similar recognition was also recorded from a municipal sewage site (Simanchala *et al.,* 2013).

Turbidity

Turbidity of pond water samples was found 79.67±4.38 NTU in oil industry while it was found maximum in paper mill effluent (248.67±7.40). The turbidity of a water sample was recorded previously100 to 200 NTU in pond water (Mishra *et al*., 2013). The turbidity of all samples was listed in the table (2).

Fluoride

A variation in the fluoride concentration was found among pond water, municipal sewage and industrial effluent. It was found maximum 0.83±0.16 mg/l in pond water, 0.5±0.00 in municipal sewage and 2.70±0.17 in industrial effluent. In the paper mill effluent maximum concentration of fluoride was recorded which is higher than our former work on paper mill effluent (Mahish *et al*., 2014).

Nitrate

Maximum nitrate concentration was recorded (2.36±0.15) from paper mill effluent followed by rice mill effluent and oil industry waste water. In the municipal sewage water concentration of nitrate was recorded 1.32±0.02 mg/l which is higher than previous work performed on municipal sewage of Bilaspur, Chhattisgarh, India (Tewari *et al*., 2014) and lower than maximum concentration recorded at Behrampur municipal corporation, Odish, India (Simanchala *et al*., 2013). In the present work, nitrate concentration of pond water was recorded between 0.91±0.10 to 0.99±0.13. The nitrate concentration in ponds of holy city Varanashi was found very high (52 mg/l) as compare to present work (Mishra *et al*., 2014). Nitrate concentration obtained from the rice mill effluent was found higher than the previous data recorded from rice mill waste water (Pradhan and Sahu, 2011).

Chloride

In the present study maximum chloride concentration was recorded 70±10.01 mg/l from the dairy industry while minimum concentration was obtained from municipal sewage (20±0.00 mg/l). The pond water contains chloride from 26.67±3.33 (mean) to 36.67±6.67 which is found lower than the pond in Durg (308 mg/l), Varanashi (40.28-131.35 mg/l), West Bengal (55.44-443.11 mg/l), and Khandwa (8-40 mg/l) (Thakur and Das, 2012; Mishra *et al*., 2014; Nag and Gupta, 2014; Mahajan and Billare, 2014). The present work revels with the study done by Kolhe and Pawar (2011) that the dairy industry takes a much higher concentration of chloride. The previous surveys done in municipal sewage and rice mill effluent contain high level of chloride as compare to the present study (Tewari *et al*., 2014; Pradhan and Sahu, 2011).

Hardness

Hardness was recorded from all water samples. Maximum hardness was obtained from municipal sewage water (640±17.34) followed by dairy and oil industry (553.33±13.02 and 408.33±10.08). Hardness of the pond water recorded from previous investigator, it was ranged from 210 to 400 (Mishra *et al*., 2014) which is higher than present study on pond water. A variation in the hardness of municipal sewage waster was recorded from 33 to 3850 mg/l (Simanchala *et al*., 2013; Tewari *et al*., 2014). The hardness of rice mill effluent in the present study was recorded 336.67±6.01 which is higher than the hardness of rice mill previously recorded (Pradhan and Sahu, 2011).

Iron

In the present investigation maximum concentration of iron was recorded from the rice mill effluent (0.46±0.02 mg/l) followed by dairy industry (0.43±0.06 mg/l) while minimum value was recorded from pond water (0.26±0.02 mg/l). The iron concentration of the pond water was recorded previously 0.6 mg/l (Verma *et al.,* 2012) while in industrial effluent in was found maximum 0.75 mg/l (Mahish *et al*., 2014).

Arsenic

Arsenic concentration was recorded very low from all studied samples including pond water, municipal sewage and industrial effluent.

Dissolve Water (DO)

Dissolve water is the very important indicator of water health. The pond water contain 8.00±0.57 and 9.33±0.32 mg/l from Ranisagar and Budhasagar pond, which is higher than DO recorded previously from pond water (Dixit *et al*., 2015; Mishra *et al*., 2014). The

municipal sewage contains 5.66±0.32 DO which is similar to the data obtained from municipal sewage previously recorded (Simanchal *et al*., 2013). Dissolve oxygen of dairy and paper mill effluent was recorded 5.00±0.00 and 7.00±0.57 mg/l which were higher than the previous study done on dairy (3.5) mg/l and Paper mill effluent (6.12) (Kolhe and Pawar, 2011; Mahish *et al*., 2014). In the present work rice mill and oil industry contain 6.00±0.00 and 4.33±0.32 mg/l of DO which is also higher than previous work done in rice mill and oil industry effluent (Pradhan and Sahu, 2011; Verla *et al*., 2014).

Biochemical Oxygen Demand (BOD)

During the study, maximum BOD was recorded 163±3.78 mg/l from oil industry while minimum value was recorded from Budhasagar pond (18.67±2.33). A broad range of BOD was recorded from previous survey done in pond water, 7.28 mg/l (Verma *et al*., 2012); municipal sewage, 58.77-112.42 (Tewari *et al.,* 2014); paper mill effluent, 72.36 (Mahish *et al.,* 2014); rice mill effluent, 450 (Pradhan and Sahu, 2011) and dairy industry 760 mg/l (Kolhe and Pawar, 2011).

Chemical Oxygen Demand (COD)

In the present work maximum COD was measured from oil industry (347±15.89) followed by rice mill effluent and dairy industry while minimum value was recorded from pond water (37.00±3.05). The COD of pond water was recorded previously 52.3 mg/l (Nag and Gupta, 2014) while COD of municipal sewage was found 420.62-547.25 mg/l (Tewari *et al*., 2014). Similarly, COD of paper and rice mill effluent was previously analyzed by 92.36 and 630.00 mg/l (Pradhan and Sahu, 2011). COD of industrial effluent were also found higher than the permissible limit of national standard (Table 3).

Table 2: Physico-chemical parameters of pond water, municipal sewage and industrial effluent of Rajnandgaon

S. No.	Source	Temp.	pH	Turbidity NTU	Fluoride (mg/l)	Nitrate (mg/l)	Chloride (mg/l)	Iron (mg/l)	Hardness (mg/l)	As (mg/l)	DO	BOD	COD
1	Ranisagar	22.33 ± 0.33	6.83 ± 0.03	129.33 ± 2.58	0.83 ± 0.16	0.91 ± 0.10	36.67 ± 6.67	0.26 ± 0.02	178.33 ± 1.66	0.03 ± 0.02	08.00 ± 0.57	23.67 ± 2.02	40.00 ± 3.46
2	Budhasagar	22.00 ± 0.00	7.16 ± 0.06	113.33 ± 1.32	0.67 ± 0.16	0.99 ± 0.13	26.67 ± 3.33	0.26 ± 0.02	186.67 ± 3.33	0.05 ± 0.02	9.33 ± 0.32	18.67 ± 2.33	37.00 ± 3.05
3	Municipal	22.33 ± 0.33	7.16 ± 0.06	183 ± 9.67	0.5 ± 0.00	1.32 ± 0.02	20 ± 0.00	0.26 ± 0.02	640 ± 17.34	0.03 ± 0.02	5.66 ± 0.32	35.33 ± 2.72	67.67 ± 1.57
4	Dairy Industry	22.67 ± 0.33	7.13 ± 0.06	217.67 ± 8.37	2.70 ± 0.17	1.16 ± 0.08	70 ± 10.01	0.43 ± 0.06	553.33 ± 13.02	0.1 ± 0.00	5.00 ± 0.00	78.67 ± 2.33	140.33 ± 8.26
5	Paper Industry	21.33 ± 0.33	7.10 ± 0.09	248.67 ± 7.40	1.0 ± 0.00	2.36 ± 0.15	53.33 ± 3.33	0.23 ± 0.02	198.33 ± 3.33	0.0 ± 0.00	7.00 ± 0.57	32 ± 1.52	52.67 ± 5.54
6	Rice Mill	22.33 ± 0.33	7.53 ± 0.02	158.33 ± 3.51	2.06 ± 0.28	1.85 ± 0.11	23.33 ± 3.33	0.46 ± 0.02	336.67 ± 6.01	0.05 ± 0.02	6.00 ± 0.00	90.33 ± 3.84	182.67 ± 2.33
7	Oil Industry	20.33 ± 0.33	7.23 ± 0.11	79.67 ± 4.38	0.67 ± 0.16	1.68 ± 0.06	43.33 ± 6.67	0.26 ± 0.02	408.33 ± 10.08	0.0 ± 0.00	4.33 ± 0.32	163 ± 3.78	347 ± 15.89

Table 3: Comparison of some Physico-chemical standard of CPCB (The Environmental Protection rule, 1986) with Industrial effluent of present analysis

S. No.	Parameters	Units	Standard of CPCB	Oil industry	Dairy industry	Paper mill	Rice mill
1	pH	pH	5.5 – 9.0	7.23	7.13	7.10	7.53
2	BOD	Mg/l	30	163	78.67	32	90.33
3	COD	Mg/l	250	347	140.33	52.67	182.67
4	Arsenic	Mg/l	0.2	0.0	0.1	0.0	0.05
5	Fluoride	Mg/l	2.0	0.67	2.70	1.0	2.06
6	Iron	Mg/l	3.0	0.26	0.43	0.23	0.46

Conclusion

The Rajnandgaon is a semi urban town and many people are defending here on pond for different activities. The present survey is immediately helpful to understand the physicochemical parameter of Ranisagar and Budhasagar pond. The municipal water releases through the town become as large canal and get together with the Sheovnath River. Thus the present monitoring also helpful to know the donation of the municipality in River pollution. Industrial waste water also contributing the pollution of water in Sheovnath River. They are as well affecting the nearby land and flora fauna. Physico-chemical parameters of the industrial effluents were found higher than the permissible limit. Thus, the present work, monitoring of physico-chemical parameter of pond water, municipal sewage and industrial effluent will useful to aware citizens of Ranjandgaon as well as it will also useful to design an efficient control mechanism against water pollution in Rajnandgaon.

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