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AN ASSESSMENT OF THE PHYSICO-CHEMICAL PROPERTIES TO STUDY THE POLLUTION POTENTIAL OF UJJANI RESERVOIR, SOLAPUR DISTRICT, INDIA

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ABSTRACT

Sampling was made of the physico-chemical factors from 20 stations on the surface water of Ujjani dam (Yeshwantsagar reservoir), Solapur district, India. Water of Ujjani dam was studied for pollution by determining various water quality parameters, for the two season's viz, pre-monsoon and post-monsoon. The dam water is subjected to sever domestic and industrial pollution. The aim's been to determine the water quality, productivity, assess nature or mans impact and industrial pollution on the physico-chemistry of the reservoir water. Our findings highlighted the deterioration of water quality in the dam due to industrialization and urbanization. Temperature ranged between 20^0C to 32^0C. The pH range is 7.17 to 9.20. The organic pollution is sever as indicated by DO 2.21 to 7.09 mg/L and BOD 0.4 to 3.89 mg/L and also highest value of COD ranging between 9.18 to as high as 46.4 mg/L indicates industrial pollution.

Keywords: water pollution, water quality, industrial pollution, organic pollution, Ujjani dam.

INTRODUCTION

Water pollution is an acute problem in all the major rivers and dams in India. Water is known to contain a large numbers of chemical elements (Hutchinson, 1957). The interactions of both the physical and chemical properties of water play a significant role in composition, distribution and abundance of aquatic organisms (Mustapha and Omotosho, 2005). In the wake up increasing urbanization and industrialization, the pollution potential of Ujjani dam giving momentum day by day. The Ujjani dam has been built at a distance of approximately 150 km from Pune across the river Bhima (Toposheet no.47 N/4, Latitude 18^0 04' 24''N and Longitude 75^0 07' 15'' E). It has a largest storage capacity (1517GL) which measures a total length of 160 km (Including its meanderings bends) and has a maximum width of 7-8 km at some places. The aerial distance of a dam to its most upstream point and backwater at Daund is approximately 73 km.

The Mula- Mutha Rivers flow through the cities of Pimpri, Chinchwad and Pune. Due to the outburst of rapid industrialization and urbanization of these cities the Mula-Mutha carries a huge load of sediments, chemicals and discharge into river Bhima near Pargaon. It is therefore desirable to monitor the pollution level of Ujjani dam by collecting and analyzing the water samples from different places with a view to study the physical and chemical characteristics and to investigate the factors responsible for causing pollution.

MATERIALS AND METHODS

Sampling for the physico-chemical parameters were done on each station for pre-monsoon (May-2009) and post-monsoon (December-2009). As per the norms of the APHA, the water samples were collected in plastic bottles and partially tested in the field, as well as in the laboratories. Temperature was measured using Mercury in glass thermometer accurate to 0.1^0C. pH was measured using portable pH meter model type pw9418 and conductivity was measured using multirange conductivity meter model H1- 8033. Dissolved oxygen was determined by modified Winkler azide method. Biochemical oxygen demand (with duration of 5 days of incubation at 20^0C) and chemical oxygen demand (by dichromate titration method) were also estimated. Total hardness (EDTA titrimetric method) Nitrate, Phosphate and Sulphate were done using Hach spectrophotometer model DRELS.

RESULT AND DISCUSSIONS

The physico-chemical characteristics are given in the Tables 1 and 2.

Temperature

Temperature is basically important for its affects on certain chemical and biological activities in the organisms attributing in aquatic media. In the Indian subcontinent the temperature in most of water bodies ranges between 7.8 to 38.5^0C (Singhal *et al*., 1986). The temperature ranged between 20^0C to 32^0C. Lower values were obtained at station-1 during pre-monsoon (27.5^0C). The highest temperature of 32^0C was obtained at station -18. The lowest and highest values of temperature during post-monsoon were 20^0 C at station -3 and 24.2^0C at station -8. The variation is mainly related with the temperature of atmosphere and weather conditions.

pH

The PH values of water bodies (lakes) was found in alkaline side (PH>7) (Goldman and Horne, 1983) The PH ranges from 7.17 to 8.30 in pre-monsoon and 7.68 to 9.15 in post-monsoon. In general the pH values are higher in winter than other seasons. The variation can be due to

the exposure of dam water to atmosphere, biological activities and temperature changes. (Adebowale *et al*., 2008).

Electrical conductivity

In present observation the EC varies from 400 to 1800 µs/cm in pre-monsoon, and 288-962µs/cm in post-monsoon. High EC indicates a large quantity of dissolved minerals, salt thereby making it sour and unsuitable for drinking. Similar observation was also reported by Srivastava and Shina (1996).

DO

DO is one of the important parameter in water quality assessment. It reflects the physical and biological processes prevailing in the water. Non polluted surface water is normally saturated with DO. The DO varies from 2.21 to 7.0 mg/L during pre-monsoon; and 3.11 to 6.11 mg/L during post-monsoon. These values indicate relatively large organic pollution. The high temperature and low DO during pre-monsoon (summer) create favorable conditions for development of blue-green algae (Jayaraju *et al*., 1994).

BOD

BOD is the amount of oxygen required by the bacteria in stabilizing the decomposable organic matter. The aim of BOD test is to determine the amount of bio chemically oxidisable carbonaceous matter (Gupta *et al*., 2003). The BOD observations for the two seasons i.e., pre and post-monsoon vary from 0.4 to 3.27mg/l and 0.65 to 3.89 mg/l. High concentration of BOD was recorded during post-monsoon is due to huge load of sediments and sewage water from Pimpri, Chinchwad and Pune cities discharged into Mula-Mutha River.

COD

COD is the amount of oxygen consumed during the chemical oxidation of organic matter using strong oxidizing agent like acidified potassium dichromate. The COD is linked with heavy pollution from paper industries, domestic sewage and industrial effluents on the bank of river Mula-Mutha and Bhima. In present study the value vary from 9.18 to 46.4 mg/L during pre-monsoon and11.2 to 36.4 mg/L during post-monsoon. The highest values of COD indicated that most of the pollution caused by industrial effluents upstream. Similar results were also reported by Pande and Sharma (1998).

Total hardness

In most of the fresh water TH is imparted mainly by the calcium and magnesium ions, which apart from Sulphate, Chloride and Nitrates are found in combination with carbonates and bicarbonates. In the present study of Total hardness were found to be 190 to 485.2 mg/L during pre-monsoon and 344.8 to 666.2 mg/L during post-monsoon. These finding suggest that the water body of Ujjani dam is very hard. Although hard water has no known effect on health but it is unsuitable for domestic use. It also forms heat insulating scales in the boilers reducing their efficiency (Ashish Kumar and Yogendra Bahadur, 2009).

Chloride

Chlorides are found in practically all natural waters. This is the most common inorganic anion present in water. Man and animals excrete high quantities of chlorides therefore it indicates sewage contamination. Variation observed is usually associated with the hydrology of the basin (Ownbey and Kee, 1967). In the present study the value ranges from 28.36 to 70.3 mg/L during pre-monsoon and 26.45 to 56.74mg/L during post-monsoon. The relatively lower values after rainy season can be attributed to the increase in dilution of rain water. Similar results were also reported by CWPRS report 2002.

Nitrates, sulphates and phosphates

The results of the Nitrate present in Tables 1 and 2 revealed that the higher values recorded during post-monsoon (0.08 to 15.4 mg/L). This may be attributed to the oxidation of ammonia by nitrifying bacteria and biological nitrification (Seike *et al*., 1990). The lower values recorded during pre-monsoon 0.38 to 4.92 mg/L may be related to the denitrifying bacteria (Merck, 1980). The nitrate concentration during post-monsoon could be due to leaching and surface run-off of nitro phosphate fertilizer from nearby farmlands into the water.

The Sulphate concentration in the dam water were very high in both seasons i.e., is pre and post-monsoon 36.01 to 108 mg/L and post-monsoon 104.2 to 361.8 mg/L. The source of sulphate could probably be from the mineral rocks antbropogenically added and also enters with rain (Mckee and Wolf, 1976).

The Phosphate content of dam water bodies were found in the range of 0.017 to 0.99 mg/L before monsoon and 0.025 to 1.69 mg/L after monsoon. Phosphates lead to entroplication which could also lead to unpleasant taste and odour of the water when algae die decompose thus deteriorating the quality of the water (Kolo, 1996). The high concentration of Phosphate after rainy season is due to leaching of Phosphate fertilizer.

CONCLUSIONS

The biodiversity and growth of aquatic flora and fauna were found to be satisfactory in the vicinity of Ujjani reservoir. Due to rich floral growth, wide variety of birds including migratory, visit the site and take shelter around the reservoir. But, the sewage contamination appears to be the main problem of the reservoir. The pH of Ujjani reservoir is alkaline at some locations and this value increases above 9 at sampling site No. 14. The lower values of DO, along with thermal stratification could have been the major cause for fish kill during summer .Foul smell characterized and floating dead fish were seen at the Pargaon. The BOD values of water remained low. But, the COD values were very high, indicating the presence of high non-biodegradable organic matter as compared to the biodegradable dissolved organic matter. The chloride

concentration remained mostly moderate; with an exception of few sampling stations where it was found to be higher above the permissible limit.

The reservoir water of Ujjani ranges from hard to very hard category. The physico- chemical analyses of Ujjani reservoir show that it is not fit for the domestic purpose and to some extent for agricultural processes. The field observations also showed that in the townships like Bhigwan, Daund and Pargaon face dreadful health problems leading to a number of diseases subsequent to consumption of the back waters of the reservoir. The environmental situation may lead to a major health hazard unless mitigation measures are taken in near future.

Table-1. Physico-chemical data (pre-monsoon) during May-2009.

Sam. loc	Temp	pH	EC	DO	BOD	COD	Cl	TH	NO_3	SO_4	PO_4
1	27.5^0C	7.35	400	2.28	0.4	18.31	28.36	210.1	0.4231	78.76	0.092
2	28.5^0C	7.49	420	2.58	1.10	16.15	29.3	190	0.7683	36.01	0.318
3	27^0C	7.24	430	5.24	1.88	19.13	28.6	250	0.3819	63.68	0.109
4	28.3^0C	7.39	480	3.63	0.81	30.25	32.4	180.8	1.031	60.98	0.863
5	27.4^0C	8.10	501	4.04	0.42	39.11	40.8	260.7	1.128	46.18	0.736
6	29.1^0C	7.90	540	3.72	1.12	26.10	43.3	192.8	0.9231	52.3	0.082
7	29.4^0C	7.71	810	2.91	1.13	38.04	30.4	215	1.979	68.7	0.631
8	30.2^0C	7.32	440	4.03	0.72	19.22	35.8	266.2	2.631	74.9	0.115
9	27.5^0C	8.30	550	7.09	3.12	9.18	48.7	276.1	2.387	40.68	0.413
10	27.6^0C	8.08	560	5.38	2.21	13.26	56.8	260.6	4.682	70.66	0.097
11	28.4^0C	7.80	520	3.87	1.88	27.12	57.4	311.2	3.403	74.0	0.131
12	28.9^0C	8.64	480	4.91	0.92	36.09	47.9	216.7	2.987	68.4	0.264
13	29.5^0C	8.13	510	5.55	3.27	28.06	60.1	259.9	1.879	57.3	0.081
14	30.2^0C	7.47	610	4.31	2.18	13.8	38.9	287.9	0.9321	44.9	0.738
15	30.5^0C	7.17	570	3.30	1.67	24.3	43.6	459.2	3.486	108.6	0.918
16	30.7^0C	7.20	700	2.68	2.31	6.54	51.4	320.3	4.923	103.2	0.634
17	29^0C	7.79	630	4.67	1.88	18.42	60.8	428.9	2.661	80.4	0.017
18	28.5^0C	8.30	812	3.21	0.92	39.3	66.7	432.7	1.954	68.4	0.992
19	32^0C	7.38	1800	2.21	0.89	46.4	70.3	454.2	3.281	96.2	0.871
20	31.4^0C	7.19	1230	3.90	1.62	22.8	62.4	485.2	1.631	77.1	0.341

Table-2. Physico-chemical data (post-monsoon) during Dec-2009.

Sam. loc	Temp	pH	EC	DO	BOD	COD	Cl	TH	NO_3	SO_4	PO_4
1	20.5^0C	8.07	288	4.54	1.12	16.9	32.56	344.8	0.24	116.6	0.456
2	20.2^0C	8.90	301	4.92	1.45	16.8	29.44	362.3	0.52	104.2	0.364
3	20.2^0C	8.44	368	4.12	1.99	14.2	46.12	359.9	0.08	168.0	1.698
4	21.5^0C	8.81	365	3.66	0.98	11.2	42.85	434	0.98	162.2	0.211
5	21.5^0C	8.13	360	5.12	2.98	16.4	36.75	468.0	1.08	180.0	0.643
6	22^0C	8.30	498	4.85	2.45	19.5	49.58	519.4	1.13	231.0	0.638
7	22.5^0C	8.41	410	5.16	3.14	30.5	46.19	438.0	6.48	168.5	0.348
8	24.2^0C	7.99	498	4.01	2.45	29.4	29.95	458.5	2.49	226.4	0.638
9	22^0C	8.59	412	6.11	3.77	19.2	26.45	437.9	14.5	205.8	0.251
10	23^0C	8.96	409	5.86	3.46	15.4	39.25	414.7	2.64	188.9	0.891
11	22^0C	9.03	455	3.65	2.16	19.5	39.49	454.1	5.19	146.8	0.561
12	22.5^0C	8.17	369	5.57	2.45	16.4	35.46	418.2	2.47	156.4	1.064
13	23^0C	8.47	389	4.77	3.15	20.4	29.46	429.9	0.15	167.2	1.254
14	22.5^0C	9.15	409	3.11	0.65	26.8	49.40	546.3	1.46	320.0	0.824
15	23.5^0C	8.33	421	3.78	2.03	19.7	36.43	666.2	0.79	256.4	0.134
16	23.2^0C	7.98	390	3.96	1.46	26.4	30.18	557.0	3.73	256.4	0.921
17	20.6^0C	8.81	368	5.28	3.42	21.4	32.80	482.0	1.66	162.0	0.725
18	23.7^0C	7.68	485	6.01	2.45	36.4	56.74	575.0	2.42	291.4	0.216
19	23.2^0C	8.47	501	4.71	3.89	31.9	51.09	656.0	15.4	361.8	0.025
20	23^0C	8.96	962	4.37	3.43	19.8	48.19	529.8	5.48	345.0	0.794

All the results are reported in mg/L except pH, EC (µs/cm)

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REFERENCES

Adebowale K.O., F.O. Agunbiade and B.I. Olu Owolabi. 2008. Impacts of natural and anthropogenic multiple sources of pollution on the environmental conditions of Ondo state costal water Nigeria. EJEAFChe. 7(4): 2797-2811.

APHA. 1985. Standard methods for the examination of water and waste water (10^{th} Ed.) Washington, DC: American Public Health Association.

Ashish Kumar and Yogendra Bahadur. 2009. Physico-Chemical studies on the pollution potential of river Kosi at Rampur, India. W.J. of Agri. Sci. 5(1): 1-4.

CWPRS. 2002. Field investigations and laboratory studies for assessment of water quality of Panshet and Ujjani reservoirs Tech. report no. 3919.

Goldman C.R. and Horne A.J. 1983. Limnology. International Student Edition, McGrow-Hill. International Book Company, London. pp. 197-220.

Gupta S., M. Bhatnagar and R. Jain. 2003. Physico-Chemical characteristics and analysis of Fe and Zn in tube well water and sewage water of Bikaner City. Asian j. chem. 15: 727.

Hutchinson G.E. 1957. A Treatise on Limnology. Vol. 1 part-2 Chemistry of lakes. John Willey and Sons, New York.

Jayaraju P.B., Prasadrao G.D. V. and Sharma S.V. 1994. Seasonal variation in Physico-Chemical parameters and diversity in the flora and fauna of the river Munneru, A tributary to river Krishna, (A.P.) India. Aqua. Biol. 9: 19-22.

Kolo R.J. 1996. The assessment of Physico-Chemical parameters of Shiroro Lake and its major tributaries. In: Eyo A.A. (Ed) proc. of the annual conf. of Fisheries Soc. of Nigeria. pp. 262-268.

McKee J.E. and H.W. Wolf (Eds). 1976. Water Quality Criteria Publication No. 3-A, California State Water Resources Control Board.

Merck E. 1980. Complex metric Assay Methods Titriplex. Germany.

Mustapha M.K. and Omotosho J.S. 2005. An assessment of the Physico- Chemical properties of Moro Lake, Kwara State, Nigeria. African J. of App. Zoo. and Envtl. Bio. 7: 3-77.

Ownbey C.R. and D.A. Kee. 1967. Chlorides in Lake Erie. Proc. Conf. Great Lakes Res. Int. Assoc. Great Lakes Res. 10: 382-389.

Pande K.S. and S.D.Sharma. 1998. Studies of toxic pollutants in Ramganga River at Moradabad, India. Enval Geo. 1(2): 93-96.

SeikeY.J.Kondo K., Hashihitani H,Okumura M., Fujinaga K. and Date Y. 1990. Nitrogen metabolism in the brakish Lake Nakanoum. IV: Seasonal of nitrate nitrogen. Jpn. J. Limnol. 51(3): 137-147.

Singhal R.N., Swaranjeet and Davis R.W. 1986. The Physico-Chemical environment and the plankton of managed ponds in Haryana, India, Proc. Indian Acad. Sci. (Sec. B). 95: 253-263.

Srivastava R.K. and A.K. Sinha. 1996. Water quality of the river Gangaat Phaphamau (Allahabad): Effect of mass bathing during Mahakumb. Envtal. Tox. Water quality. 11(1): 1-5.