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Analysis of Water Quality using Physiochemical Parameters of Godavari River at Selected Stations of Nashik City

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ABSTRACT

A present study has been carried out to assess the water quality of Godavari river at Nasik city. Water samples from three sampling stations were collected monthly, during period of November 2014 to March 2015 and physiochemical parameters (pH, chloride, free CO_2, total dissolved solids, total alkalinity, dissolved oxygen, biological oxygen demand and chemical oxygen demand, most probable number) were analyzed by the standard methods. The pollution level over a period of time is increasing on the river water mainly due to sewage, industrial and other waste waters are directly discharge in the river. The Godavari river water is mainly used for domestic, industrial and agricultural purpose. Hence the present study is aimed to examine the water quality of the Godavari river and to evaluate the impact of such contaminated water.

1. Introduction

Water Pollution is a major environmental issue in India. The largest source of water pollution in India is untreated sewage, agricultural runoff and unregulated small scale industries. Most rivers, lakes and surface water in India are polluted. The Godavari river is considered to be one of the very sacred river of India and it is second biggest river after Ganga [1]. It is originates near Triambakeswar in Brahamagiri hills of Western Ghats, 25 km west of Nashik at elevations ranging from 1,219 to 1,524 m above sea level. The river Godavari is the main source of water supply for Nashik city. It is often referred to as the 'Vridha Ganga' or 'Dakshina Ganga'. Being a holy river most of the religious activities are performed on the bank of river Godavari and that too at Ramkund. The people believe that taking a holy dip in Ramkund relieves them from all the sins. The increased industrialization, human population and its activities and use of pesticides and chemical fertilizers in agriculture field causing heavy pollution in aquatic environment leading to deterioration water quality and depletion of aquatic biota [2]. Water sources were polluted by domestic wastage (in rural areas) and industrial wastages (in urban areas) discharged into natural water sources. According to surveys carried out on selected stretches of important rivers, it has been found that most of the rivers are grossly polluted. The domestic sewage discharged from a population of about 2 million gives rise to numerous water-borne diseases like typhoid, cholera, dysentery, poliomyelitis and cysticercosis, thereby affecting the human health and deterioration of the water quality [3]. The growing problem of degradation and human activities on river ecosystem has made it important to monitor water quality of rivers to evaluate their state of pollution. The quality of natural water is generally governed by various physico-chemical and microbiological parameters hence it is very necessary to understand the physico-chemical and bacteriological qualities of water. Therefore, the present study is aimed to evaluate the seasonal variations in physico-chemical parameters of Godavari river water from Ramkund, Panchvati and Dasak village in Nashik city.

2. Experimental Methods

2.1 Study Area

The Godavari river flows through the city and has a length of 18 km, in the area of Nashik Municipal Corporation. For the investigation of Godavari river, three sampling stations were selected i.e. Panchavati, Ramkund and Dasak village.

2.2 Sample Collection and Physiochemical Analysis

In order to determine the water quality three selected stations (Panchavati, Ramkund and Dasak village) were chosen for sample collection from Godavari river. Water samples were collected in five litter plastic containers at selected stations in early morning between 8 am to 10 am in every month from November 2014 to March 2015. For estimation of dissolved oxygen separate samples were collected in 250 mL BOD bottle. All parameters were analyzed by standard methods as prescribed by APHA [4] and WHO [5]. Details of different methods relevant to parameters are shown in Table 1.

Table 1 The various parameters and methods of determination

S. No.	Parameters	Methods	Instruments/Equipment
1	pH	Electrometric.	pH meter
2	Alkalinity, mg/L	Acid-base titrimetric method	-
3	Chloride, mg/L	Mohr's method, Titration by $AgNO_3$	-
4	Free CO_2, mg/L	Titration by NaOH	-
5	TDS, mg/L	Electrometric	Conductivity/TDS meter
6	DO, mg/L	Titration by sodium sulphate solution.	-
7	BOD, mg/L	Winkler's method, 5 days incubation at 20°C followed by titration.	BOD incubator
8	COD, mg/L	Winkler's method, 5 days incubation at 20°C followed by titration.	COD incubator
9	Bacteriological test	MPN	-

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3. Results and Discussion

The physiological analysis results of selected locations of Godavari river water with WHO limits are given in Tables 2 – 4.

3.1 pH

It is one of the most important parameter in water chemistry and measured as intensity of acidity or alkalinity or measures the concentration of hydrogen ions in water. The effect of pH on the chemical and biological properties of liquids makes its determination very important. The difference between pH values at different stations in various months of the year was significant. The maximum pH was recorded as 8.4 and 8.1 at sampling location Dasak village and Ramkund in November. Significant changes in pH also occur due to religious activities, industrial and domestic waste disposal. Seasonal variations may be due to variation in the photosynthetic activity which increases pH due to consumption of CO_2 in photosynthetic process. When compare to the standard values of WHO the water samples acceptable during all duration throughout year and safe for all use. Kolhe and Shinde [6] and Bhor et al [7] found same results of pH of Godavari river at Ramkund.

3.2 Total Alkalinity (TA)

Primarily Alkalinity composed of carbonate and bicarbonate and it is ability to neutralize strong acid and can determine by titrating sample with strong acid. Alkalinity in boiler water essentially results from the presence of hydroxyl and carbonate ions. In polluted natural water, the alkalinity is chiefly due to presence of bi-carbonate of alkali. pH and hardness affect the toxicity of many substances in the water. In present investigations, the maximum alkalinity value (280 ppm) in December and it was recorded minimum (101 ppm) in January. Present investigation results show that the total alkalinity was low in summer season and high in winter season. Similar findings have been recorded by Deshmukh [8] and Nagarkar [9].

3.3 Chloride (Cl^-)

Chloride is available in all types of water. In natural fresh water amount of chloride is generally very low. Maximum source of chlorides in fresh water is disposal of sewage and industrial waste. Presence of chloride above the usual concentrations in water is also used as an indicator of pollution by domestic sewage. In present analysis, chloride concentration was found maximum 145 mg/L in month of Nov. 2014. This gradually decreased in month of March 2015 and minimum i.e. chloride content 92.5 mg/L was observed. Most of the water samples collected from study area was lower than the prescribed limits 0- 200 mg/L of WHO. From above discussion, chloride content was found to be within the normal limits. Similar finding has been recorded by Deokar [10].

3.4 Free CO_2

The important source of free CO_2 in surface water bodies is mainly from respiration of aquatic organisms [11]. The recorded and calculated values of free CO_2 were fluctuating seasonally. In the present study, range of CO_2 value was quite wide and showed seasonal fluctuations. Table 2, 3 and 4 show monthly and seasonal fluctuations from February to March, the CO_2 value shows high fluctuations. Meantime CO_2 values were low from November to January at Panchvati and Ramkund respectively. Deshmukh [8] reported same results of free CO_2 at various stations of Gangapur dam.

3.5 Total Dissolve Solid (TDS)

Total dissolved solid at the measure of all kinds of solids which are suspended in a water sample, total dissolved solid can be measured as the residue left after evaporation of the samples. The total dissolved solids in water are considered as the desirable limit for drinking purposes which larges from 200 mg/L as maximum permissible limit of WHO [5]. The TDS of Godavari river ranged from 108.4 to 925.4 mg/L at various sampling stations. The higher value (925.4 mg/L) of TDS was observed at Ramkund due to various human activities and mixing of sewerage, detergent and soaps required for cloth washing in the Godavari river (Fig. 1a and Fig. 1b). Similar results about TDS of Godavari river was recorded by Bhor et al [7] and Bawa and Gaikawad [12] respectively.

3.6 Dissolve Oxygen (DO)

Dissolve Oxygen is one of the most important parameter to indicate water purity and maintain aquatic life. It regulates the metabolic process of aquatic organisms. Two main sources of DO in water i.e. oxygen in water can be dissolved from air or is produced by photosynthetic activity within water. In the present investigation it was observed that the level of dissolved oxygen does not fluctuate much throughout the whole session. The maximum dissolved oxygen was recorded (10.4 mg/L) in November and minimum was recorded (3.2 mg/L) in March. These results are identical to those reported by Deshmukh [8] and Pawar [13].

Table 2 Results of physiological parameters of water at Panchvati in Nashik

Parameter	Unit	Month					WHO
		Nov	Dec	Jan	Feb	March	
pH	-	7.4	6.2	7.5	7.2	6.5	7.0-8.5
Alkalinity	mg/L	192	280	103	145	123	120
Chloride	mg/L	105	119	93	133	125	250
Free CO_2	mg/L	35.2	22	17.5	52.8	26.4	-
TDS	mg/L	538	488	583	426	284	500
DO	mg/L	7.2	4.7	6.2	5.5	3.2	4-6
BOD	mg/L	8.2	5.7	5.5	4.2	9.6	06
COD	mg/L	59.68	54.80	42.48	45.48	52.55	10
MPN	Units/mL	1786	1658	1400	1612	1791	-

Table 3 Results of physiological parameters of water at Ramkund in Nashik

Parameter	Unit	Month					WHO
		Nov	Dec	Jan	Feb	March	
pH	-	8.1	7.7	7.1	7.6	7.5	7.0-8.5
Alkalinity	mg/L	102	256	136	136	141	120
Chloride	mg/L	102	96	108	108	98	250
Free CO_2	mg/L	14.08	12.8	8.8	24.64	24.01	-
TDS	mg/L	542	925	648	610	108	500
DO	mg/L	10.4	4.2	9.6	6.2	5.4	4-6
BOD	mg/L	6.4	6.4	7.1	5.8	7.2	06
COD	mg/L	55.47	42.74	58.92	57.14	53.10	10
MPN	Units/mL	1820	1000	1452	1700	1125	-

Table 4 Results of physiological parameters of water at Dasak village in Nashik

Parameter	Unit	Month					WHO
		Nov	Dec	Jan	Feb	March	
pH	-	8.4	7.1	6.5	7.4	5.4	7.5-8.5
Alkalinity	mg/L	145	177	101	154	105	120
Chloride	mg/L	109	145	129	145	92	250
Free CO_2	mg/L	40.9	25.3	47.02	47.21	19.32	-
TDS	mg/L	642	847.5	525.4	628.4	164.8	500
DO	mg/L	7.2	3.8	3.3	5.8	4.7	4-6
BOD	mg/L	6.6	7.7	4.2	6.9	9.6	6
COD	mg/L	60.20	50.18	61.78	32.48	56.19	10
MPN	Units/mL	1662	1200	1420	1568	1230	-

3.7 Biological Oxygen Demand (BOD)

Biological Oxygen Demand is amount of oxygen required by microorganism for stabilizing biochemical decomposable organic matter in water under aerobic conditions [8]. In present investigation, maximum value (9.6 mg/L) was recorded in March at sampling station Panchvati and Dasak village, while minimum value (4.2 mg/L) in January and February. Increase in values in summer season due to high temperature. In 2013, Bawa and Gaikawad [12] also reported maximum BOD value of Godavari river.

3.8 Chemical Oxygen Demand (COD)

COD determines the oxygen required for chemical oxidation of organic matter. COD values convey the amount of dissolved oxidisable organic matter including the non-biodegradable matters present in it. Concentration of COD of the Godavari river water ranged from 32 -65 mg/L at various sampling sites. The high value of COD (65.48 mg/L) was recorded in month of February at Panchvati station, due to mixing of domestic and industrial effluent in the river water (Fig. 1c and Fig. 1d). Same finding was reported at Godavari river by Bawa and Gaikawad [12] and Kolhe and Shinde [6].

3.9 Coliform Record - MPN Test

The coliform group includes a broad diversity in terms of genus and species, whether or not they belong to the *Enterobacteriaceae* family. It is Gram negative, non-spore forming, rod shaped bacteria that ferment lactose with gas and acid formation within 48 h at 35 °C (multiple-tube fermentation technique). In present investigation, The most probable number (MPN) for the presumptive total coliform count of the river water samples ranged from 1000 to 1820 MPN/100 mL. The higher bacterial value (1820) was observed at Ramkund in month of November

this might be due to various rites and rituals are performed here and water is used for bathing and washing also (Fig. 1e and Fig. 1f). The direct discharge of waste water from Nashik and area around the city. In present study, the MPN value of water was observed beyond the permissible limit of drinking. Similar high value of MPN was also observed by Singh et al [14] and Kolhe and Shinde [6].

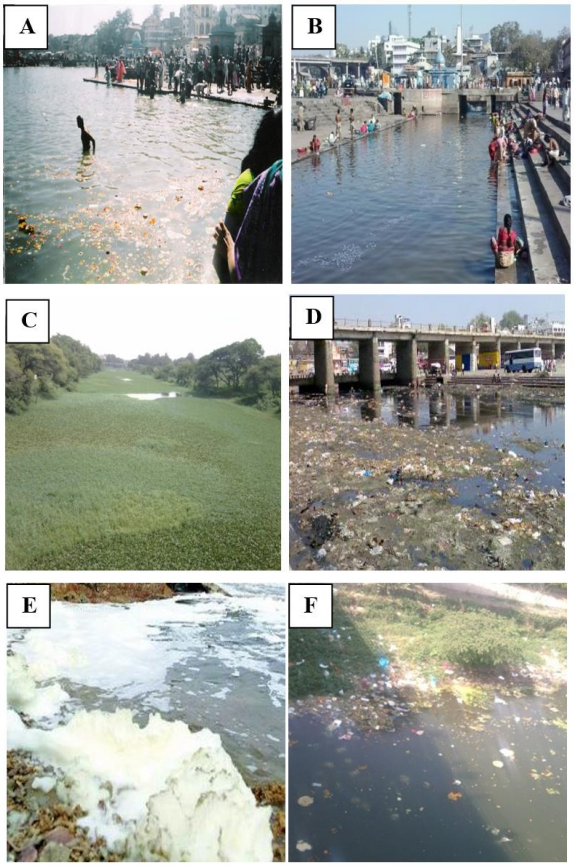

Fig. 1 a) Pollution in Godavari due to religious activities in Ramkund.
b) Washing of clothes and vehicles in Ramkund.
c) Heavy degree of Eutrophication in panchvati.
d) Heavy garbage pollution at Panchvati.
e) Foaming observed at Dasak.
f) Disposal of Garlands and other holy wastes in Dasak.

4. Conclusion

The present study result shows that, the quality of water at different sampling stations may not be suitable for aquatic life as well as for using domestic purposes. The water quality parameters alkalinity, TDS, DO, BOD, COD and MPN values are well within the WHO permissible limits. The TDS in Ramkund and Dasak village was good as above the WHO permissible limit and the average of alkalinity and COD has exceeded the desirable limits which are due to different human activities and improper drainage system of the different units and it is believed that continuous pollution of the water sources by various human activities may lead to some health problems to human. It was found that the most of the parameters were exceeding the permissible limit of WHO, so that the water in the selected stations are not suitable for drinking purposes.

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