

Water Quality Status Of River Ganges In Respect Of Physico Chemical And Microbial Characteristics At Anupshahar, District-Bulandshahar (India)

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Abstract

A study was carried out to assess the water quality status of river Ganga with respect to physico-chemical and bacteriological characteristics at Anupshahar town (Tehsil of distt. Bulandshahar). To collect the samples. Before sampling point-B, several sewage drains discharge their effluent into river Ganga and bathing ghat activities are also held after sampling point- A. Parameters studied ranged from pH 7.0-8.97, Total Solids 112-902 mg/l, Total Dissolved Solids 90-262gm/l, Fixed Dissolved Solids 30-76mg/l, Conductivity 0.16-0781 μ mhos/cm, Alkalinity 59-110mg/l, Hardness 61-119mg/l, DO 9.8-12.6mg/l, BOD 1.2-5.5mg/l, COD 12-35mg/l and Total Coliform 700-24000 MPN /100ml. But out of these parameters the average values of BOD (3.483mg/l,) and total coliform bacteria (5408 MPN/100ML) at sampling point-B and BOD (2.25 mg/l,) and total coliform bacteria (3445 MPN/100 ml) at sampling point-A were obtained beyond the tolerance limits of drinking purpose. However, average values of these parameters were found higher at sampling point-B than sampling point-A which may be due to contaminations of sewage water of the town as well as bathing activities held before sampling point-B. Nature of water quality of river Ganga with respect to pH is alkaline. Present paper indicates that water quality of river Ganga is not suitable for drinking purpose with respect to BOD and bacteria within the range of study area.

Introduction

Anupshahar is Tehsil of district Bulandshahar (UP) which is situated at the bank of river Ganga where number of people take bath daily. Anupshahar is connected through the roads of Aligarh, Bulandshahar and Narora Atomic power plant. Narora Atomic power plant is situated 20km away from Anupshahar in down stream of Ganga. National capital of India (Delhi) is about 130 km away in west and Aligarh city 55km in south-west from Anupshahar. Ganga river passes through the cities/towns such as Rishikesh, Haridwar, Bijnor, Garhmukteshwar, Anupshahar and Narora etc. There are several bathing ghats and domestic sewage drains from where waste water reaches the river. Main Hindu festivals are also organized at bathing ghats of the town. Number of workers have carried out their investigations on water quality of river Ganga with respect to different physico-chemical and microbiological characteristics from its origin to merging point (Singh *et al*, 1988,89,91,93,94, Khanna *et al*, 2003; Gautam and Sati 1987). But no study has been conducted to assess the water quality of river Ganga at Anupshahar. Therefore it was proposed to conduct a study on water quality of river Ganga at this town (Anupshahar). This town is having population approximately 40 thousand. The present paper includes one year study (April-2001-March-2002).

Materials and Methods

Water samples of River Ganga were collected in neat and two litre white plastic Jericanes for general parameters and samples for coliform bacteria were collected in 125 ml sterilized Borosil glass stoppered bottles. Samples for Dissolved Oxygen (DO) were collected in a neat and clean 300 ml capacity Borosil glass stoppered DO bottles DO was fixed by using 1ml. of each reagents MnSO_4 and alkaline azide on the spot of sampling points. Grab sample collection methods was adopted through out the study. Sample preservation and analytical methods

were adopted as per APHA, AWWA, WPCF-(1992) Trivedi and Goel (1984) Kotiah and Kumaraswami (1994). All chemicals, reagents and solvents were used for the analysis of analytical grade procured from Qualigens and SD. fine chemicals and glass wares used were of Borosil make. Instruments used were pH meter, Conductivity meter, BOD incubator, Hot air oven, Bacteriological incubator, Water bath and Muffle furnace were of best company make.

Two sample points were selected as U/s-Anupshahar denoted as sampling point-A and D/s Anupshahar denoted as sampling point-B. Sampling point-A is approximately 500 metre in upstream of Anupshahar and sampling point-B is situated 1km in D/s of Anupshahar. There is a bathing ghat at river bank of Ganga just after sampling point-A and several small or medium sewage drains are merging into Ganga river before sampling point-B.

Results and Discussion

Samples analysed for physico-chemical and bacteriological parameters are given in Table-1&2 and their minimum, maximum and average values are given in Table-3. Prescribed standards of tolerance limits for drinking purpose are mentioned in table -4 to compare the results of studied characteristics to evaluate the water quality of river Ganga (BIS-1991 & CPCB-1997).

The values of studied parameters pH, TS, TDS, FDS, Conductivity, DO, BOD, COD, alkalinity, hardness, Ca-Hardness, Mg-Hardness, Chloride and Total coliform varied between 7.42-8.81; 112-883 mg/l; 90-183 mg/l; 30-56mg/l; 0.16-0.65 μ mhos/cm; 10.7-12.6mg/l, 1.2-3.6mg/l; 12-32mg/l; 59-100mg/l; 61-119mg/l; 49-70mg/l; 12-49mg/l; 7.2-29.4 mg/l; and 700- 16000 MPN/100 ml respectively at sampling point-A where as at sampling point-B the values of these parameters ranged from 7.0-8.97; 122-902 mg/l; 96-262 mg/l; 31-76 mg/l; 0.172-0.781 μ mhos/cm; 9.8-12.0 mg/l; 2.0-5.6 mg/l; 13-35 mg/l; 62-110 mg/l; 65-110 mg/l; 51-76 mg/l; 14-34 mg/l; 8.4-60.8 mg/l; and total coliform bacteria 1100-24000 MPN/100 ml respectively. The average values of pH, TS, TDS, FDS, Conductivity, DO COD, alkalinity, hardness and chloride were obtained within the prescribed tolerance limit of drinking purpose (BIS-1991 & CPCB-1997) where as average values of BOD (2.25 mg/l and 3.48 mg/l) and Total coliform bacteria 3445 MPN/100ml and 5408 MPN/100 observed were beyond the standard limits at both the sampling point-A and B (Table-3&4).

Maximum values of the studied parameters were observed during summer season and shock load of first rain in rainy season except DO and minimum values of these parameters obtained during winter, while higher values of DO were observed during rainy period at both sampling points which may be due to dilution in rainy period and super saturation of oxygen at lower ambient temperature and less human activities like bathing /washing etc. in winter. After winter period as temperature of the environment rises bathing washing and other human activities are also increased which gradually deteriorates the water quality of river Ganga. It is very interesting to note that an enhancement in the values of the studied parameters are obtained at sampling point-B more than sampling point-A, It is because of several small/big sewage drains discharging their effluents into river Ganga and due to daily conducting bathing washing activities at bathing ghats situated before sampling point-B. Water quality of river Ganga with respect to pH is alkaline in terms of bacteria, may cause diseases that vary in severity from mild gastroenteritis to severe and sometime fatal dysentery, cholera or typhoid (WHO-1984). Similar trends of water quality of river Ganga were also found by (Singh-1988, 89 and Khanna-2003). Therefore it is the duties of concerned authorities as well as people of the area to protect such contaminations and bathing/washing by soaps because Ganga river is a most sacred river and worshiped by the Hindus. Public awareness is most essential specially for those who are responsible to pollute the natural water quality of river Ganga.

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Table 1 : Results of Physico-Chemical and Microbial Characteristics at Sampling Point-A (Year 2001-2002)

Parameters	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1. Physical Parameters												
Ambient Temp.(°C)	28±0.20	38±0.40	41±0.80	32±0.60	29±0.40	30±0.30	31±0.20	30±0.16	25±0.40	18.2±0.20	22.6±0.21	29.4±0.30
Water Temp.(°C)	21±0.40	22.3±0.30	23±0.40	21.1±0.20	20.8±0.20	20.9±0.10	20.6±0.20	20±0.12	19.5±0.07	14.6±0.52	15±0.63	20.4±0.50
pH	8.03±0.06	8.08±0.05	8.19±0.30	8.81±0.30	8.7±0.30	8.64±0.20	8.3±0.02	7.96±0.12	7.61±0.0	7.42±0.08	7.68±0.14	7.7±0.08
T.S (mg/l)	138±6.10	257±7.40	424±10.0	660±18	883±0.22	719±0.20	306±0.12	201±8.0	170±5.6	116±2.4	112±3.0	132±2.6
T.D.S (mg/l)	116±4.2	130±3.0	156±4.8	165±3.6	183±3.4	179±3.2	182±3.4	178±3.6	150±2.0	96±1.6	90±1.2	110±2.1
F.D.S (mg/l)	36±0.8	41.6±1.0	46±1.2	48.9±1.4	56±1.3	45±1.6	42.2±1.4	40±1.8	36±1.1	30±0.8	32±1.0	40±0.6
Cond.(mMhos/cm)	0.26±0.02	0.27±0.03	0.40±0.04	0.65±0.03	0.58±0.50	0.521±0.20	0.43±0.01	0.34±0.01	0.241±0.0	0.16±0.0	0.176±0.0	0.209±0.0
2. Chemical Parameters												
D. O (mg/l)	11.5±0.8	11.2±0.6	10.7±0.5	11±0.8	12.1±0.7	11±0.2	11.2±0.04	11±0.01	12±0.08	12.6±0.2	11.8±0.12	11±0.1
C.O.D (mg/l)	14±0.9	18±1.0	22±1.4	29±1.2	32±1.6	26±1.2	24±0.03	20±0.9	16±0.4	12±0.2	12.4±0.14	13±0.12
B.O.D (mg/l)	1.8±0.1	2±0.3	2.9±0.2	3.6±0.2	3±0.3	2.6±0.2	1.8±0.0	1.6±0.06	1.2±0.01	1.8±0.01	2±0.01	2.4±0.01
Alkalinity (mg/l)	69±0.4	74±1.2	76±1.2	79±0.8	81±1.0	74±0.9	100±3.2	90±0.08	76±1.2	59±1.1	60±0.8	65±1.0
T. Hardness (mg/l)	75±0.6	78±1.4	90±1.4	119±1.8	80±0.8	85±1.0	86±2.4	84±1.3	78±1.0	81±1.3	68±1.0	77±1.3
Ca- Hardness(mg/l)	60±0.5	58±0.3	66±0.8	70±0.9	54±0.4	60±0.5	66±1.2	60±0.7	58±0.8	49±0.5	54±0.9	80±1.5
Mg- Hardness(mg/l)	15±0.3	20±0.2	24±0.3	49±0.3	26±0.2	25±0.2	20±0.4	24±0.4	20±0.08	12±0.7	14±0.03	17±0.1
Chloride(mg/l)	12.9±0.6	20±0.8	21.5±0.0	29.4±0.3	26±0.3	18.6±0.2	10±0.2	8±0.04	7.4±0.03	7.2±0.2	7.5±0.1	7.9±0.03
NO ₂ (mg/l)	0.016±0.0	0.022±0.0	0.0231±0.0	0.039±0.0	0.020±0.0	0.016±0.0	0.014±0.0	0.013±0.0	0.011±0.0	0.01±0.0	0.012±0.0	0.016±0.0
NO ₃ (mg/l)	0.085±0.0	0.094±0.01	0.106±0.02	0.412±0.08	0.30±0.01	0.08±0.03	0.09±0.0	0.085±0.0	0.06±0.0	0.03±0.0	0.04±0.0	0.05±0.0
3. Metals												
Chromium(mg/l)	0.001±0.0	0.002±0.0	0.002±0.0	0.003±0.0	0.003±0.0	0.002±0.0	0.002±0.0	0.001±0.0	0.001±0.0	0.00±0.0	0.001±0.0	0.001±0.0
Cobalt(mg/l)	0.00±0.0	0.00±0.0	0.00±0.0	0.002±0.0	0.001±0.0	0.00±0.0	0.00±0.0	0.00±0.0	0.00±0.0	0.00±0.0	0.00±0.0	0.00±0.0
Copper(mg/l)	0.020±0.01	0.03±0.0	0.041±0.0	0.048±0.01	0.049±0.0	0.049±0.01	0.036±0.0	0.028±0.0	0.21±0.0	0.02±0.0	0.025±0.0	0.03±0.0
Iron(mg/l)	0.206±0.06	0.312±0.04	0.463±0.06	0.912±0.04	0.865±0.0	0.790±0.02	0.641±0.01	0.460±0.10	0.280±0.01	0.19±0.0	0.189±0.0	0.198±0.0
Lead(mg/l)	0.002±0.0	0.004±0.0	0.005±0.0	0.006±0.0	0.006±0.0	0.004±0.0	0.003±0.0	0.002±0.0	0.001±0.0	0.001±0.0	0.001±0.0	0.0015±0.0
Nickel(mg/l)	0.02±0.01	0.02±0.0	0.03±0.01	0.06±0.01	0.05±0.0	0.045±0.0	0.036±0.0	0.024±0.0	0.013±0.0	0.01±0.0	0.01±0.0	0.02±0.0
Potassium(mg/l)	2.4±0.09	2.8±0.08	2.8±0.08	5.6±0.10	3.2±0.09	2.9±0.01	2.8±0.01	2.6±0.01	2.2±0.05	2.0±0.01	2.1±0.01	2.2±0.01
Sodium(mg/l)	12.8±1.0	13±1.4	13.2±0.5	48±2.0	20±0.80	16±0.80	13.1±0.03	13±0.04	12.6±0.4	11.8±0.3	11.6±0.05	12±0.06
Zinc(mg/l)	0.06±0.02	0.065±0.01	0.081±0.04	0.107±0.01	0.098±0.0	0.090±0.01	0.082±0.0	0.074±0.0	0.042±0.0	0.015±0.0	0.02±0.0	0.039±0.0
4. Microbial Parameters												
Total Coliform (MPN/100ml)	1100±20	1700±30	1400±50	16000±210	9200±80	3400±60	2500±50	2200±50	1100±51	940±20	700±20	1100±40
S.P.C/ml	34±1.2	56±1.8	78±2.1	161±4.2	130±3.1	95±2.8	41±1.2	36±2.1	25±1.1	25±0.8	18±0.4	30±1.2

Table 2 : Results of Physico-Chemical and Microbial Characteristics at Sampling Point-B (Year 2001-2002)

Parameters	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1. Physical Parameters												
Ambient Temp.(°C)	28.2±0.30	38±0.20	42±0.40	32±0.50	29±0.20	30±0.40	31±0.50	30±0.20	25±0.50	18.2±0.30	22.6±0.30	29.4±.50
Water Temp.(°C)	21.6±0.20	22.4±0.10	22.9±0.30	21.0±0.20	20.6±0.20	20.7±0.10	20.4±0.30	20.1±0.10	19.2±0.10	14.8±0.30	15±0.40	20.3±.20
pH	8.18±0.20	8.23±0.30	8.39±0.20	8.97±0.50	8.83±0.30	8.64±0.20	8.76±0.50	8.52±0.30	8.04±0.20	7.61±0.50	7.6±0.30	7±0.50
T.S (mg/l)	198±8.10	282±11.20	590±18.50	902±15	898±21.2	799±2.50	452±3.12	239±4.80	172±3.40	122±2.10	125±1.80	122±2.0
T.D.S (mg/l)	166±2.1	192±3.5	200±4.2	262±5.10	188±7.30	190±4.2	192±4.8	139±4.8	130±5.70	98 ±3.50	101±2.80	96±1.9
F.D.S (mg/l)	56±1.2	70±1.8	68±1.7	76±1.3	50±2.0	46±2.10	44±2.10	43±1.5	48±1.9	38±1.7	36±1.6	31±1.4
Cond.(mMhos/cm)	0.252±0.0	0.26±0.0	0.484±0.0	0.781±0.02	0.71±0.02	0.702±0.01	0.68±0.01	0.61±0.0	0.424±0.02	0.172±0.1	0.211±0.1	0.219±0.1
2. Chemical Parameters												
D. O (mg/l)	10.8±0.02	10.1±0.03	9.8±0.2	10.8±0.18	11.6±0.13	11.2±0.12	10.9±0.10	11.2±0.18	12±0.20	12±0.16	11.1±0.17	9.8±0.20
C.O.D (mg/l)	18±0.16	22±0.15	25±0.18	32±0.17	35±0.45	29±0.27	26±0.21	22±0.08	20±0.06	13.8±0.04	13±0.04	13.9±0.05
B.O.D (mg/l)	2.6±0.03	3.9±0.04	4.8±0.03	5.6±0.06	4.5±0.02	4.3±0.03	4.2±0.02	2.1±0.01	2±0.01	2.4±0.01	2.6±0.01	2.8±0.01
Alkalinity (mg/l)	82±1.2	100±1.5	108±1.1	110±1.1	82±0.80	86±0.9	101±0.10	98±0.00	82±2.0	62±1.2	65.1±1.5	66.2±1.4
T. Hardness (mg/l)	88±1.4	95±1.1	100±1.2	110±1.7	81±1.8	98±1.1	92±1.5	100±1.7	90±1.6	65±1.3	69±1.5	80±1.2
Ca- Hardness(mg/l)	68±2.4	69±2.0	70±1.8	76±1.3	55±1.5	76±2.1	72±2.10	72±2.3	64±3.10	51±2.9	54±2.7	66±2.0
Mg- Hardness(mg/l)	20±0.17	26±0.17	30±0.11	34±0.15	26±0.13	22±0.18	20±0.13	28±0.17	26±0.21	14±0.31	15±0.42	14±0.21
Chloride(mg/l)	14±0.21	42±0.23	36±0.18	60.8±0.16	26.6±0.14	22±0.19	18±0.18	16±0.12	14±0.10	8.4±0.11	8.9±0.13	9.2±0.15
NO ₂ (mg/l)	0.020±0.0	0.031±0.0	0.042±0.0	0.055±0.0	0.023±0.0	0.025±0.0	0.018±0.0	0.016±0.0	0.013±0.0	0.04±0.0	0.015±0.0	0.017±0.0
NO ₃ (mg/l)	0.091±0.0	0.20±0.0	0.14±0.0	0.52±0.0	0.40±0.0	0.29±0.0	0.096±0.0	0.09±0.0	0.08±0.0	0.035±0.0	0.049±0.0	0.052±0.0
3. Metals												
Chromium(mg/l)	0.002±0.0	0.002±0.0	0.003±0.0	0.003±0.0	0.002±0.0	0.002±0.0	0.001±0.0	0.001±0.0	0.001±0.0	0.00±0.0	0.001±0.0	0.0015±0.0
Cobalt(mg/l)	0.002±0.0	0.003±0.0	0.001±0.0	0.002±0.0	0.00±0.0	0.00±0.0	0.00±0.0	0.00±0.0	0.00±0.0	0.00±0.0	0.00±0.0	0.01±0.0
Copper(mg/l)	0.03±0.03	0.03±0.0	0.044±0.0	0.072±0.0	0.048±0.0	0.46±0.0	0.049±0.0	0.045±0.0	0.036±0.0	0.015±0.0	0.028±0.0	0.032±0.0
Iron(mg/l)	0.38±0.38	0.406±0.0	0.564±0.01	0.998±0.02	0.89±0.01	0.861±0.01	0.72±0.01	0.67±0.01	0.58±0.01	0.21±0.0	0.206±0.0	0.31±0.0
Lead(mg/l)	0.001±0.0	0.002±0.0	0.009±0.0	0.009±0.0	0.007±0.0	0.007±0.0	0.005±0.0	0.004±0.0	0.003±0.0	0.0012±0	0.0025±0	0.004±0.0
Nickle(mg/l)	0.02±0.0	0.03±0.0	0.035±0.0	0.08±0.0	0.052±0.0	0.051±0.0	0.049±0.0	0.043±0.0	0.037±0.0	0.01±0.0	0.015±0.0	0.021±0.0
Potassium(mg/l)	2.6±0.01	3±0.01	3.9±0.01	6.2±0.20	4.6±0.04	3.7±0.08	3.2±0.01	3.0±0.01	2.8±0.02	1.9±0.01	1.8±0.0	2.4±0.02
Sodium(mg/l)	14±0.08	15.1±0.07	15.9±0.08	57±0.05	30±0.15	18±0.25	13.5±0.88	18±0.09	13.4±0.15	12.6±0.14	12.8±0.15	13.4±0.15
Zinc(mg/l)	0.08±0.0	0.08±0.0	0.096±0.0	0.172±0.0	0.104±0.0	0.096±0.0	0.85±0.0	0.81±0.0	0.072±0.0	0.021±0.0	0.022±0.0	0.039±0.0
4. Microbial Parameters												
Total Coliform (MPN/100ml)	1700±30	2200±40	2200±42	24000±140	16000±110	9200±80	2400±46	2200±38	1400±20	1100±16	1100±18	1400±22
S.P.C/ml	49±2.0	76±3.0	110±4.6	220±5.2	173±4.8	131±3.0	85±1.8	48±1.6	30±1.1	49±1.8	29±1.2	49±2.1s

Table-3 : Water quality status of river Ganga in respect of Physico Chemical and Bacteriological Characteristics at Anupshahar (Bulandshahar) during the study period 2001-02

Parameters	2001-02			2001-02		
	Sampling Point-A			Sampling Point-B		
	Minimum	Maximum	Average	Minimum	Maximum	Average
pH	7.42	8.81	8.09	7.0	8.97	8.4
Total solids (mg/l)	112.0	883.0	343.17	122.0	902.0	408.41
TDS (mg/l)	90.0	183.0	144.45	96.0	262.0	162.8
FDS (mg/l)	30.0	56.0	41.14	31.0	76.0	50.5
Conductivity (μ mhos/cm)	0.16	0.65	0.35	0.172	0.781	0.45
DO (mg/l)	10.7	12.6	11.5	9.8	12.0	10.94
BOD (mg/l)	1.2	3.6	2.25	2.0	5.6	3.48
COD (mg/l)	12.0	32.0	19.87	13.0	35.0	22.48
Alkalinity (mg/l)	59.0	100.0	75.25	62.0	110.0	86.86
Total hardness (mg/l)	61.0	119.0	81.75	65.0	110.0	89.0
Ca-hardness (mg/l)	49.0	70.0	59.58	51.0	76.0	66.08
Mg-hardness (mg/l)	12.0	49.0	22.16	14.0	34.0	22.917
Chloride (mg/l)	7.2	29.4	14.69	8.4	60.8	29.04
Total Coliform (MPN/100ml)	700.0	16000.0	3445.0	1100.0	24000.0	5408.0

Table-4 : Standards of water quality for drinking purpose in terms of physico-chemical characteristics (BIS-1991 & CPCB-1997)

Parameters	Standard Limits
Colour	Colourless
Odour	Odourless
pH	6.5-8.5
TDS (mg/l)	500.0
Conductivity (μ mhos/cm)	1.0
DO (mg/l)	>6.0
BOD (mg/l)	2.0
Total hardness (mg/l)	300.0
Calcium hardness (mg/l)	200.0
Magnesium hardness (mg/l)	100.0
Chloride (mg/l)	250.0