Indian J.Sci.Res.2(4) : 41-44, 2011

PHYSICO-CHEMICAL PROPERTIES OF THE WATER OF RIVER GANGA AT GHAZIPUR

R.C. YADAV[a1] AND V.C. SRIVASTAVA[b]

Department of Botany, Harish Chandra P.G. College, Varanasi, U.P., India
[a]E-mail: rcy200@yahoo.com
[b]E-mail: vcsrivastava_vns@rediffmail.com

ABSTRACT

Physico-chemical properties of the water of River Ganga were studied at five different sites, viz, Site I[st] -Patthar Ghat Site II[nd] -Bada Mahadeva Ghat Site III[rd] -Dadari Ghat Site IV[th] -Collector Ghat Site V[th] -Chitnath Ghat during the September 2005 to August 2007 rin river Ganga at Ghazipur U.P. Depletion in the dissolved oxygen, and increase in temperature, total solids, electrical conductance, pH, Biochemical Oxygen Demand, Chemical Oxygen Demand, chloride, acidity, total alkalinity, total hardness, calcium, phosphate ,nitrate, sodium and potassium. Analysis observation reveal variation in the values of temperature fom17 0.55 -33.90 0.58°C, Total solids from 260 1.5 -1035 15.71 mgL^{-1}, Electrical conductance from 189.4 0 12.99 -1046.00 30.79 mhos, pH from 7.33 0.03-9.69 0.06, DO from 1.20 0.08 - 9.90 0.18 mgL^{-1}, BOD from 2.27 0.02 -197.70 4.69 mgL^{-1}, COD from 3.31 1.251-376.41 9.63 mgL^{-1}, Chloride from 9.8 0.67-165.40 1.92 mgL^{-1}, Acidity from 1.49 0.07 68.92 1.72 mgL^{-1}, Total alkalinity from 140 5.02 462 10.96 mgL^{-1}, Total hardness from 38.071 .08 -960.10 13.20 mgL^{-1}, Calcium from 14.30 0.61-89.50 4.04 mgL^{-1}, Phosphate from 0.003 0.001 - 1.26 0.03 mgL^{-1} Nitrate from 0.014 0.002-1.39 0.03 mgL^{-1}, Sodium from 11.90 0.96-247.40 5.52 mgL^{-1}, Potassium from 4.9 0.31-52.80 1.33 mgL^{-1}.

KEYWORDS: Dissolved oxygen, biochemical oxygen demand, chemical oxygen demand

The Ganga rises in the Garhwal Hima1ayas (30°55' N, 79°7' E) under the name of Bhagirathi. The ice-cave of Gomukh at the snout of Gangotri glacier approximately 4100 meters above sea level is recognized as the traditional source of the Ganga. The river cuts its path through the Himalayas till another head stream, the Alakhnanda joins at Deveprayag and below this confluence the united stream is generally known as the Ganga. After a run of some 250 kilometers Ganga reaches Rishikesh and after another 30 km it reaches the Indo-Gangetic plain at Haridwar, where it swells into a mighty stream 750 meters wide. The total length of Ganga river is about 2525 Km. The main townships of Uttarakhand and Uttar Pradesh falling at bank of Ganga river are Rishikesh, Haridwar, Garhmukteshwar, Narora, Kannauj, Kanpur, Dalmau, Allahabad, Mirzapur, Varanasi, Ghazipur, Ballia and goes upto the Bay of Bengal in the Indian Ocean.

The Ganga river flows its way receiving hardly any tributary till it is joined by the Kali and Ramganga at Kannauj. At Kanpur, a local river called Pandu meets Ganga. After flowing about 1050 Km. from its origin, the Ganga is joined by Yamuna at Al1ahabad, which actually contributes more water than the main river itself. It is from Allahabad downwards that the Ganga river receives several major tributaries at more frequent intervals like the Tons, Gomati, Ghaghara, Gandak, Burhi Gandak, etc.

Physico-chemical characteristics of river water affect the biological characteristics and indicate the status of water quality analysis of river water quality (APHA 1998, Bhargava, 1977; Tripathi, 1982 and 1983), oxygen relationship in river (Gunnerson and Bailey, 1963), atmospheric reaeration in river (Hornberger and Kelly, 1975), behaviour of phosphate, nitrate, chloride and hardness in rivers (Broker, 1984), river water quality (Nair et al., 1989), modelling of water quality based on emission limits for industrial discharges in rivers (Ragas and Leuven, 1999), optional allocation of waste loads in a river (Li and Morioka, 1999), nitrogen levels in river (Mitchell et al., 2001).

MATERIALS AND METHODS

Sample Collection and Preservation

Samples of the river Ganga water were collected at monthly intervals from the selected sites in the first week of each month (from September 2004 to August 2006). Triplicate samples, each of two litres in polythene bottles were collected between 8 A.M. to 10 A.M. from each sampling site and brought to the laboratory in ice boxes for the analysis of various physico-chemical parameters. Temperature of water samples were recorded on the sampling

[1]**Corresponding author**

sites immediately with the help of Celsius thermometer. Dissolved oxygen was fixed on the sampling sites with manganous sulphate and alkali-iodide-azide for analysis.

Analysis of River Water

Various physico-chemical analyse of river water were done by Standard Methods described by for the Examination of Water and Waste water as prescribed by American Public Health Association, 1998. All the instructions were followed and precautions were taken as mentioned in IBP handbook No.8 by Golterman et al.,1969.

Pollution Sources of Study Sites

After a thorough survey from the entry point of river Ganga to end point of water flow in Ghazipur district the following five pollution sources have been observed and selected for study point of view in the city of Ghazipur approximately 5 sq km river flow of water.

The data were collected for a period of twelve months from September 2004 to August 2006 from five different sites, and their average values of each month have been cited in the text.

Site I. (Patthar Ghat)

It is situated at upstream where the river enters into the domain of city of Ghazipur which has least human disturbances and it is almost free from domestic pollution.

Site II. (Bada Mahadeva Ghat)

It is situated at downstream of Patthar Ghat with temple on its bank. It receives moderate amount of domestic pollution from residential habitations and effluents from Lard's Distillery, Nandganj.

Site III. (Dadari Ghat)

It is situated in the middle of city and receives domestic sewage as well as industrial effluents from the Government Opium and Alkaloids works, Ghazipur. It is worth to mention that the volume of mixed sewage discharge into the river at the ghat is more than any other single discharge point within the city where the demarcation between the polluted water and river water can be seen easily.

Site IV. (Collector Ghat)

It is further downstream and receives huge amount of domestic sewage, because of dense residential population in habitation.

Site V. (Chitnath Ghat)

It is situated at the end of city where population and human disturbances are less.

RESULTS AND DISCUSSION

The results of physico-chemical analyses of the river water reveal that the water temperature ranged from a minimum of 17 ± 0.55 °C at site- I in January 2006 to a maximum of 33.90 ± 0.58 °C at site -III in the month of June 2006. Seasonally the values were highest in summer season followed by rainy and winter season. The observation of total solids reveals that the monthly variation ranged from a minimum 260 ± 11.5 mgL^{-1} at site-I in February 2006 to a maximum of 1035 ± 15.71 mgL^{-1} at site-III in the month of August 2006. Seasonally, the values were highest in rainy season and lower in winter and the intermediate values were recorded in summer season. The observation of EC reveals that the monthly variation ranged from a minimum 189.40 ± 12.99 mhos at site-I in January 2005 to a maximum of 1046.00 ± 30.79 mhos at site-III in the month of August 2006. Seasonally, the values were highest in rainy season and lower in winter and the intermediate values were recorded in summer season. The observation of pH reveals that the monthly variation ranged from a minimum of 7.33 ± 0.03 at site-IV in August 2006 to a maximum of 9.69 ± 0.06 at site-III in the month of June 2005. Seasonally, the values were highest in summer and lower in rainy and the intermediate values were recorded in winter season.

The observation of do in reveals that the monthly variations ranged from a minimum of 1.20 ± 0.08 mgL^{-1} at site-III in July 2005 to a maximum of 9.90 ± 0.18 mgL^{-1} at site-I in the month of February 2006. Seasonally, the values were highest in winter season and lower in summer and intermediate values were recorded in rainy season. The value of DO during summer months is lower due to higher temperature and high rate of microbial decomposition of organic matter.

The observation of BOD reveals that the monthly variation ranged from a minimum of 2.27 ± 0.02 mgL^{-1} at site-I in December 2005 to a maximum of 197.70 ± 4.69 mgL-1 at site-III in the month of June 2005. Seasonally, the

values were highest in summer followed by rainy and winter season. Similar findings have also been reported by Tiwari (1983), Sikandar (1987) and Shukla et al. (1988) in Varanasi. However, present findings indicate slightly lower BOD values in all the months at Ghazipur than at Varanasi which is due to comparatively low incorporation of city sewage. The observation of COD reveals that the monthly variation ranged from a minimum of 3.31 ± 1.251 gL^{-1} at site-I in December 2004 to a maximum of 376.41 ± 9.63 mgL^{-1} at site-III in the month of June 2006. Seasonally, the values were highest in summer followed by rainy and winter season. Similar findings have been recorded by Shukla et al. (1989) at Varanasi in river Ganga water. Slightly lower value of COD has been recorded at Ghazipur in comparison with Varanasi possibly due to low organic load.

The observation of chloride reveals that the monthly variation ranged from a minimum of 9.8 ± 0.67 mgL^{-1} at site-I in September 2004 to a maximum of 165.40 ± 1.92 mgL^{-1} at site-III in the month of May 2006. Seasonally, the values were highest in summer and lower in rainy and intermediate value were recorded in winter season. Similar results have been observed by Tripathi (1982) and Shukla et al. (1989).

The observation of acidity that the monthly variation ranged from a minimum 1.49 ± 0.07 mgL^{-1} $CaCO_3$ at site-I in February 2005 to a maximum of 68.92 ± 1.72 mgL^{-1} $CaCO_3$ at site-III in the month of July 2005. Seasonally, the values were highest in summer season decreased gradually during rainy and winter season. Similar trend of results have been observed by Mitra (1982) on river Godavari and Tungbhadra. However, slightly lower values of acidity were recorded in comparison to the river Ganga at Varanasi reported by Shukla et al., (1989).The observation of total alkalinity reveals that the monthly variation ranged from a minimum 140 ± 5.02 mgL^{-1} $CaCO_3$ at site-I in September 2005 to a maximum of 462 ± 10.96 mgL^{-1} $CaCO_3$ at site-III in the month of July 2005. Seasonally, the values were highest in summer season followed by winter and rainy season months. . The results are in concurrence with the observations of Tripathi (1982), Tiwari (1983) and Sikandar (1987). During rainy season low values of alkalinity was possibly due to dilution of river water with rain-water. The observation of total hardness reveals that the monthly variation ranged from a minimum of 38.07 ± 1.08 mgL^{-1} at site-I in October 2005 to a maximum of 960.10 ± 13.20 mgL^{-1} at site-III in the month of June 2006. Seasonally, the values were highest in summer which gradually decreases in rainy and sharp decrease in winter season. The observation of calcium reveals that the monthly variation ranged from a minimum of 14.30 ± 0.61mgL^{-1} at site-I in September 2005 to a maximum of 189.50 ± 4.04 mgL^{-1} at site-III in the month of April 2006. Seasonally, the values were highest in summer and lower in rainy and intermediate values were recorded in winter season. Calcium was one of the most important factors because eutrophication depends on its contents in a water-body.

The observation of phosphate reveals that the monthly variation ranged from a minimum of 0.003± 0.001 mgL^{-1} at site-I in February 2006 to a maximum of 1.26 ± 0.03 mgL^{-1} at site-III in the month of June 2006. Seasonally, the values were highest in summer gradually decreases in rainy and winter season. Similar observation is in concurrence of the findings of Sikandar (1987) and Shukla et al., (1989). The observation of nitrate reveals that the monthly variation ranged from a minimum of 0.014 ± 0.002 mgL^{-1} at site-I in October 2004 to a maximum of 1.39 ± 0.03 mgL^{-1} at site-III in the month of June 2005. Seasonally, the values were highest in summer and lower in rainy and intermediate value were recorded in winter season. Higher NO_3 values during summer may possibly be due to increase in the degradation of organic matter by microbial activities.

The observation of sodium reveals that the monthly variation ranged from a minimum of 11.90 ± 0.96 mgL^{-1} at site-I in October 2004 to a maximum of 247.40 ± 5.62 mgL^{-1} at site-III in the month of August 2006. Seasonally, the values were highest in summer and lower in rainy and intermediate value were recorded in winter season. The observation of potassium reveals that the monthly variation ranged from a minimum of 4.9 ± 0.31 mgL^{-1} at site-I in January 2006 to a maximum of 52.80 ± 1.33 mgL^{-1} at site-III in the month of June 2006. Seasonally, the values were highest in summer gradually decreases rainy and winter season months. A more or less similar trend has also been observed by Tiwari (1983).

REFERENCES

American Public Health Association, APHA. 1998. Standard methods for examination of water and wastewater (20th ed.). Washington, DC.

Bhargva D.S., 1977. Water quality in three typical rivers in U.P. Ganga, Yamuna and Kali. Ph.D. Thesis IIT, Kanpur.

Brooker M.P., 1984. The behavior of phosphate, nitrate, chloride and hardness in 12 Welsh Rivers (U.K.). J. Wat. Res., **18**(9) : 1152-1164.

Golterman H.L., Clymo R.S. and Ohnstand M.A.M., 1969. Methods of chemical analysis of fresh water, I and II Handbook 8: Blackwell Oxford.

Gunnerson C.G. and Bailey T.E., 1963. Oxygen relation in sarcamento river. J. Sanit Eng. Div. Am Soc. civ Engrs., **89** : 95-124.

Hornberger G.M. and Kelly M.G., 1975. Atmospheric reaeration in a river using productivity analysis. J. Environ. Div., **101** :729-739.

Li S.Y. and Morioka T., 1999. Optional allocation of waste loads in a river with probabilistic tributary flow under transverse mixing. Wat Environ. Res., **71**(2) : 156-162.

Mitchell A.W., Reghenzani J.R. and Furnas M.J., 2001. Nitrogen levels in the Tully River a long-term view. Wat. Sci. and Tech., **43**(9) :107-114.

Mitra A.K., 1982. Chemical, Characteristics of surface water at a selected ganging station in the river Godavari, Krishna and Tungbhadra. Indian J. Environ. Hlth., **24**(2) : 165-179.

Nair N.B., Arunachalam M., Madhusoodan N.K.C., and Suryanarayanan H., 1989. A spatial study of the Neyyar river in the light of the river continuum - concept. Trop. Ecol., **30**(1) : 101-110.

Ragas A.M.J., and Leuven R.S.E.W., 1999. Modelling of water quality-based emission limits for industrial discharges in river. Wat. Sci. Technol., **39**(4) : 213-220.

Shukla S.C., Tripathi B.D., and Prasad N.,1988. Physio-Chemical and bacteriological characteristics of river Varuna at Varanasi. J. Scientific Res., **38** : 133-141.

Shukla, S.C., Kant, R. and Tripathi, B.D., 1989. Ecological. investigation on physio- chemical characteristics and phytoplankton productivity of river Ganga at Varanasi. Geobios, **16** : 20-27.

Sikandar, M., 1987. Ecology of river Ganga with special reference to pollution. Ph.D. Thesis. B.H.U., Varanasi.

Tiwari D., 1983. Pollution Phycology of the Varanasi Frontage of River Ganga. Ph.D. Thesis B.H.U., Varanasi.

Tripathi C.K.M., 1982. Investigation on Ganga River to Determine Biological Indicators of Water Quality. Ph.D. Thesis, B.H.U. Varanasi.

Tripathi G., 1983. Environmental problems of Indian Rivers and their ill effects. River Pollution and Human Hlth. R.S. Ambasht and B.D. Tripathi (Eds.), NECA, Varanasi:23-33 .