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ANALYSES OF SOME PHYSICOCHEMICAL PARAMETERS OF A TRIBUTARY OF GANGA, WEST BENGAL, INDIA

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ABSTRACT
Hooghly River water near Kolkata, West Bengal, India has been considered to assess the physico-chemical characteristics. The water samples from four sites namely, Konnagar Bataghat, Baromandir ghat Ghoshpara ghat, and Sakherbazar ghat were collected and analyzed from September, 2010 to August 2011. Parameters such as dissolved oxygen, free carbon dioxide and BOD were compared with the standard desirable limit of those parameters in river water. The analytical data of free carbon dioxide and BOD indicated above, and dissolved oxygen is found below the normal limit in some water samples of the study areas indicating signified pollution of river water, which first affects its physico-chemical quality and then systematically decimates the aquatic community and disconcerting the delicate food web.

KEY WORDS: Hooghly River, dissolved oxygen, free carbon dioxide and BOD.

INTRODUCTION

Hooghly river system which is considered as lifeline for the people of West Bengal, also known as Bhagirathi-Hooghly is tributary of the river Ganga. The river divides from the Ganga as a canal near Farakka of Murshidabad district and enters in South Bengal as Hooghly. Another part enters Bangladesh as river Padma. While flowing through West Bengal, the river is receiving both the industrial and domestic effluents because the biggest industrial as well as densely populated areas of India are located beside the river Hooghly (Chakraborty and Gupta, 2003). A numerical model on salinity and circulation in the Hooghly estuary has been given by Mc Dowell and Prandle (1972). Joshi *et al*. (2009) has been reported some parameters like pH, total dissolved solid, turbidity, sodium *etc.* were found to be in excess than the prescribed limit in some water samples of the river Ganga. But due to limitation of the information on physicochemical characteristics of the Hooghly River, an attempt has been made to overcome these lacunas.

METHODOLOGY

The study sites were extended about 6kms, situated at West bank of Hooghly River (a tributary of Ganga) of West Bengal, India. This is an important industrial area and four sampling stations were considered namely, Station A (Konnagar Bataghat), Station B (Baromandir ghat), Station C (Ghoshpara ghat) and Station D (Sakherbazar ghat). This area was selected due to number of high drain and nallas (canals), those carries large amount of sewage and effluents including discharge from several factories, household and cattle yard directly fall into the river. Sometimes human and cattle carcasses are thrown into the river. Some ghats are used for bathing, ritual activities like burning dead bodies in an old traditional method, cattle wallowing and washing clothes especially with detergents. Defecation and brick-kilns along the bank of the river is another problem of river Hooghly. Samples of subsurface water were collected fortnightly in the early hours of the day *i.e.* between 7 am to 8 am for twelve months from September, 2010 to August 2011. Care was taken to avoid spilling of water and air bubbling at the time of sample collection. Some of the physico-chemical characteristics of water including dissolved oxygen, free carbon dioxide, BOD were determined at the sampling stations. Water analyses were done according to the APHA (1998). Data were subjected to statistical analysis (Zar, 2009).

RESULTS & DISCUSSION

Dissolved oxygen (DO) content of Ganga water at Station-A (Konnagar Bataghat) ranged from 2.1 to 7.29 mgl^{-1} with minimum in February and maximum in September (Fig. 2). In this sampling station the mean value of the DO is 4.08 ± 1.78mgl^{-1} (Table-1). DO content of Ganga water at Station- B (Baromandir ghat) ranged from 2.57 mgl^{-1} to 6.98 mgl^{-1} with minimum in February and maximum in September (Fig.1). In this sampling station DO content of Ganga water at the mean value of the DO was 4.06±1.63 mgl^{-1}. DO content of Ganga water at Station- C (Ghoshpara ghat) was ranging from 0.67mgl^{-1} to 4.39 mgl^{-1} with minimum in February and maximum in September and an average of 2.31±1.03 mgl^{-1} (Fig. 3). Whereas, at Station- D (Sakherbazar ghat) minimum and maximum DO was 1.49 and 8.11 mgl^{-1} during February and September respectively with an average of 3.80 ±2.04 mgl^{-1} (Fig.4). Pooled data indicates a mean of 3.56 ±0.84 mgl^{-1} DO in the study area (Table -2).

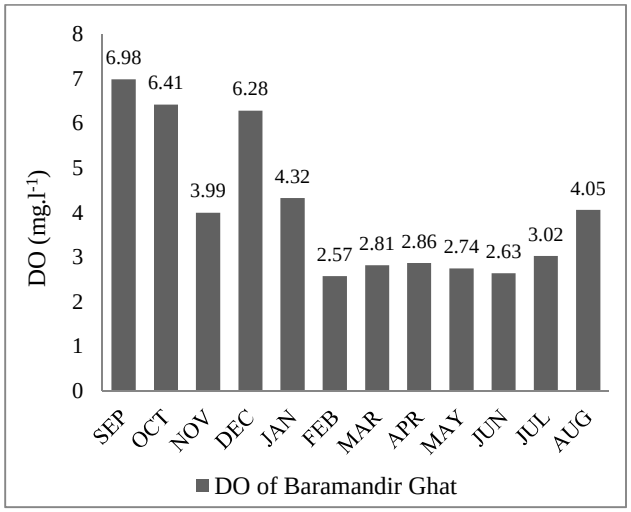

FIGURE 1. DO of Baramandir Ghat water

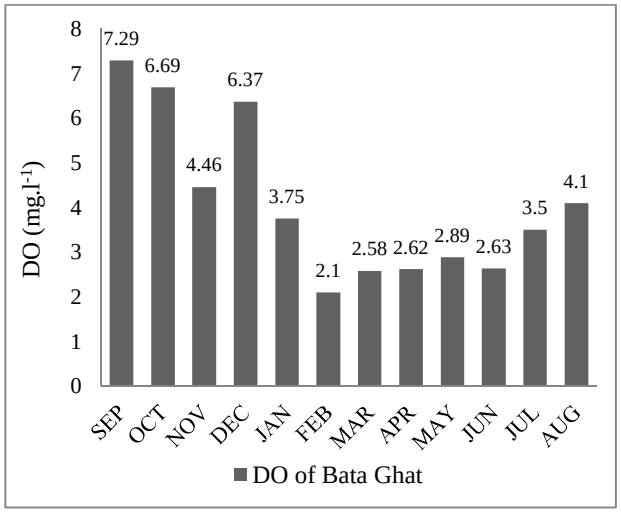

FIGURE 2. DO of Bata Ghat water

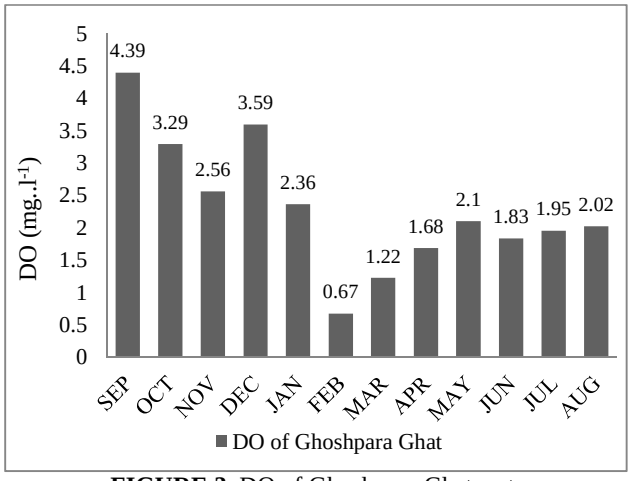

FIGURE 3. DO of Ghoshpara Ghat water

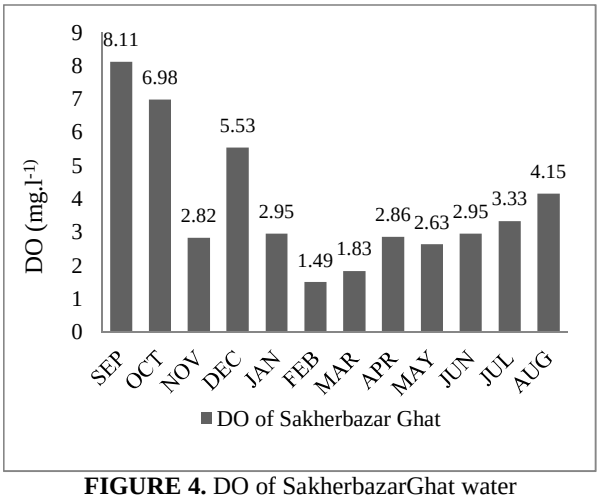

FIGURE 4. DO of SakherbazarGhat water

TABLE 1: Mean values with S.D. of different parameters of different stations

Sampling station →	Baramandir Ghat	Bata Ghat	Ghoshpara Ghat	Sakherbazar Ghat
DO ($mg.l^{-1}$)	4.06 ± 1.63	4.08± 1.78	2.31± 1.03	3.80± 2.04
Free CO_2 ($mg.l^{-1}$)	3.995 ± 1.42	4.24 ± 1.81	8.75 ± 3.46	3.77 ± 1.29
BOD ($mg.l^{-1}$)	1.37 ± 0.89	1.69 ± 0.65	1.67 ± 1.09	1.67 ± 1.15

TABLE 2: Analysis of total studied region of Hooghly River

DO ($mg.l^{-1}$)	3.56 ± 0.84
Free CO_2 ($mg.l^{-1}$)	5.19 ± 2.38
BOD ($mg.l^{-1}$)	1.60 ± 0.15

Free carbon dioxide of Ganga water at Station A ranged from 2.11 to 7.3 mgl^{-1} with minimum in June and maximum in September. In this sampling station the mean value of the free CO_2 is 4.24 ±1.81 mgl^{-1} (Table-1) (Fig. 6). At station B the range was 2.33 mgl^{-1} in January and maximum 6.54 mgl^{-1} during September with a mean value of 3.995 ±1.42 mgl^{-1} (Fig. 5). Free CO_2 at station C ranged from 2.11 mgl^{-1} to 13mgl^{-1} with minimum in June and maximum in September. In this sampling station the mean value was 8.75±3.46 mgl^{-1} (Fig.7). Station D exhibited a range from 1.8 to 5.9 $mg.l^{-1}$ free carbon dioxide with an average of 3.77 ±1.29 mgl^{-1} (Fig.8). Pooled data showed a mean of 5.19 ± 2.38 mgl^{-1} free carbon dioxide in the study area (Table -2). Biological oxygen demand (BOD) of Ganga water at Station-A ranged from 1.13 to 3.11 mgl^{-1} with minimum in January and maximum in September (Fig.10). In this sampling station the mean value of the BOD is 1.69 ±0.65 mgl^{-1} (Table-1). BOD at Station-B ranged from 0.66 to 3.23 $mg.l^{-1}$ with minimum during February and maximum in September with a mean of 1.37 ±0.89 mgl^{-1} (Fig. 9). At Station-C BOD of Ganga water ranged from zero to 3.61 mgl^{-1} during February-March (minimum) and September (maximum) respectively with an average of 1.67 ±1.09 mgl^{-1} (Fig. 11).Station D showed

a range of 0.3 to 4.09 mgl^{-1} BOD, minimum in February and maximum in September, with an average of 1.67 ± 1.15 mg.l^{-1} (Fig.12). Pooled data revealed a mean of 1.60 ± 0.15 mg.l^{-1} BOD in the study area (Table -2).

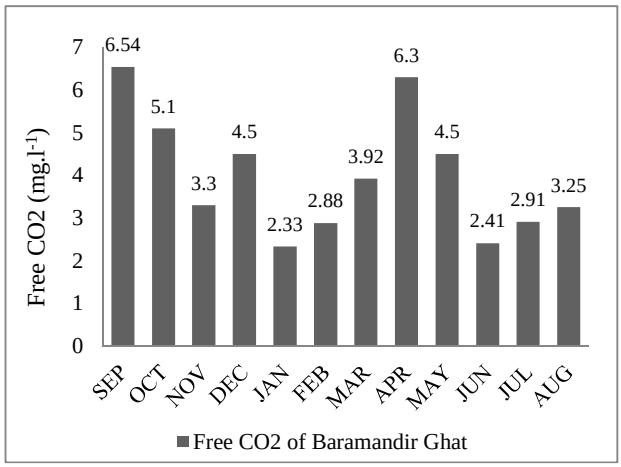

FIGURE 5. Free CO_2 of Baramandir Ghat water

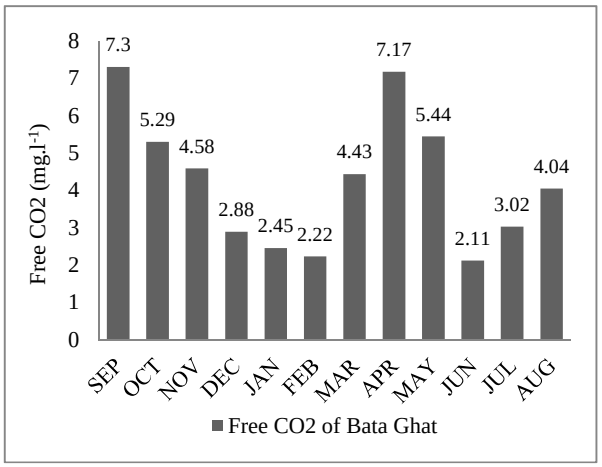

FIGURE 6. Free CO_2 of BataGhat water

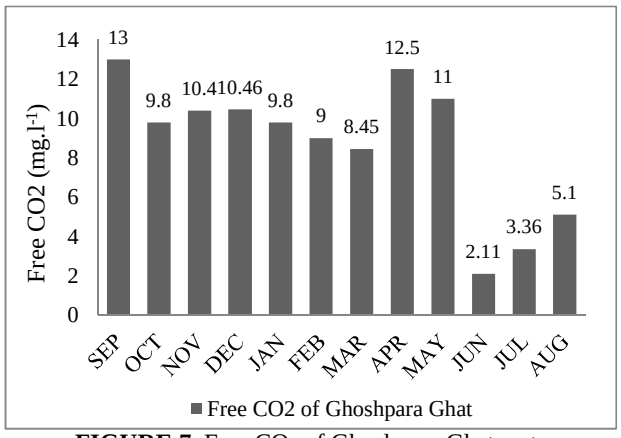

FIGURE 7. Free CO_2 of Ghoshpara Ghat water

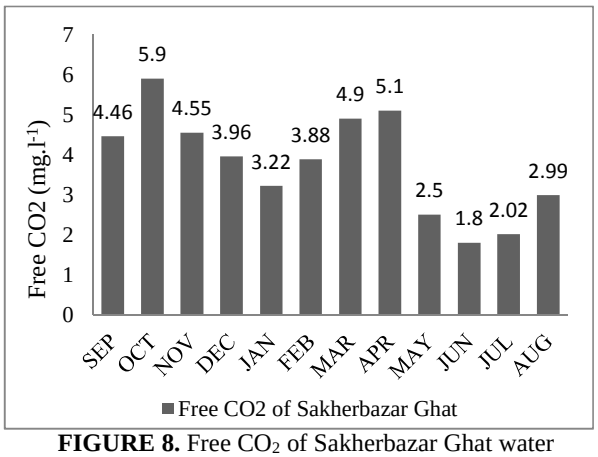

FIGURE 8. Free CO_2 of Sakherbazar Ghat water

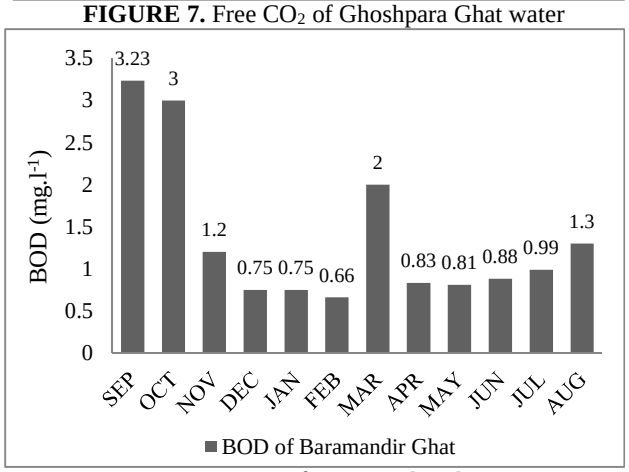

FIGURE 9. BOD of Baramandir Ghat water

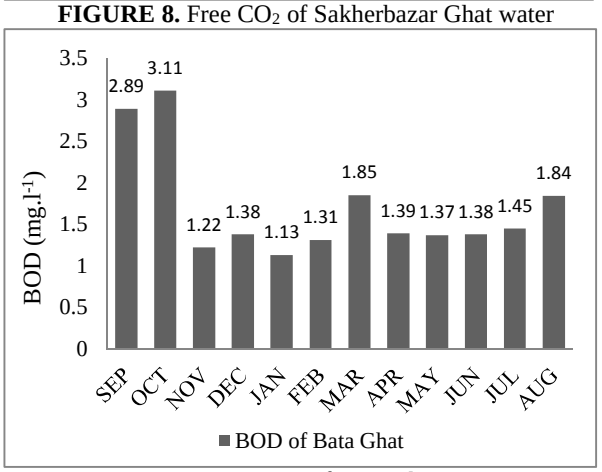

FIGURE 10. BOD of Bata Ghat water

Statistical analysis revealed a significant relation between DO-CO_2 ($r = 0.683$, $t = 3.09$, $p < 0.05$, $Y = 1.092+0.465x$, $F = 7.16$, $p < 0.05$) and CO_2 –BOD ($r = 0.50031$, $t = 2.23$, $p < 0.05$, $Y = 4.494+ 0.434x$, $F = 42.277$, $p < 0.05$).

The mean value of the dissolved oxygen (DO) of the total studied area of Hooghly River was 3.56± 0.84 mg.l^{-1} (Table -2). It was below the normal level 5 mg.l^{-1} (Parmar *et al*., 2011). In all the stations DO content was higher during September to January i.e. monsoon to winter and maintained a low level from February to June with increasing surrounding temperature. The temperature influences the solubility of oxygen in water as DO saturation is based on the temperature of the water, because warmer water is disable to dissolved higher amount of oxygen (Sadhuram *et al*., 2005). With the advance of season, after monsoon, increase of algal as well as phytoplankton growth leads to increase in photosynthesis and subsequent DO in water. This was in

conformity with the work of Roy (1998) who observed higher DO during and after monsoon and at the end of winter and advancement of summer activity of coliform bacteria gradually increased. It helps to degrade organic matters by consuming oxygen and DO level decreased in the month of summer and indicates organic pollution. Moreover gradual decreased in DO during November to March was probably due to maximum growth of zooplankton (Kreutzweiser *et al*., 2004). The study revealed that DO level in water was dropped below normal range which put aquatic life in this region under stress (Fig.13). The lowest DO recorded at Ghoshpara ghat in February (0.67 $mg.l^{-1}$) and the oxygen level below 1-2 $mg.l^{-1}$ for a few hours can result in large fish kills (Cunha-Santino *et al*., 2008).

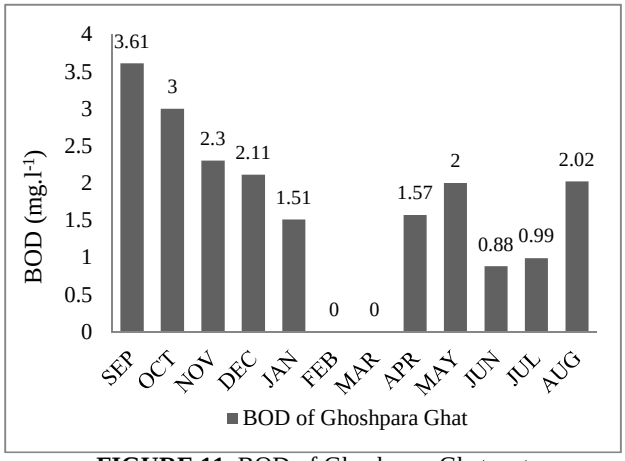

FIGURE 11. BOD of Ghoshpara Ghat water

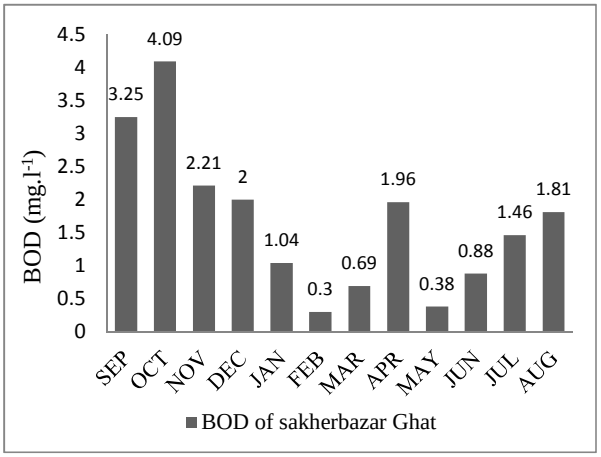

FIGURE 12. BOD of Sakherbazar Ghat water

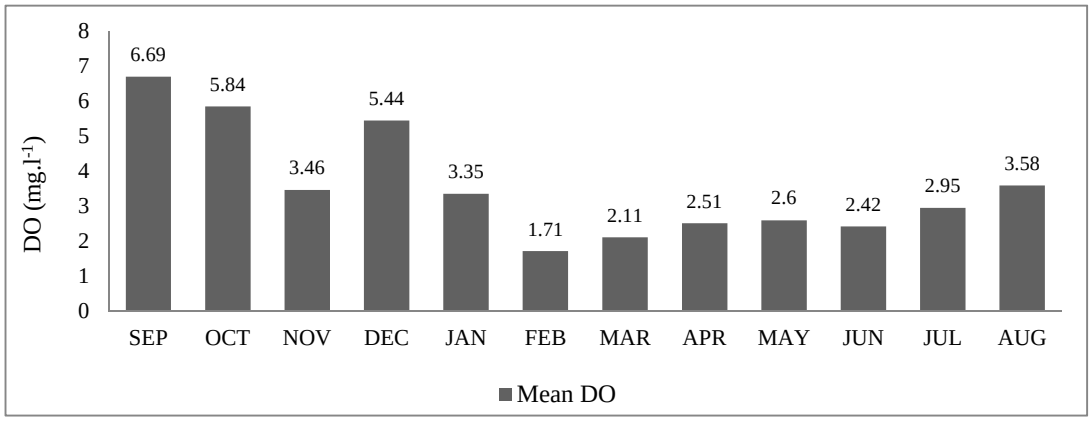

FIGURE 13. DO of total studied region of Hooghly River

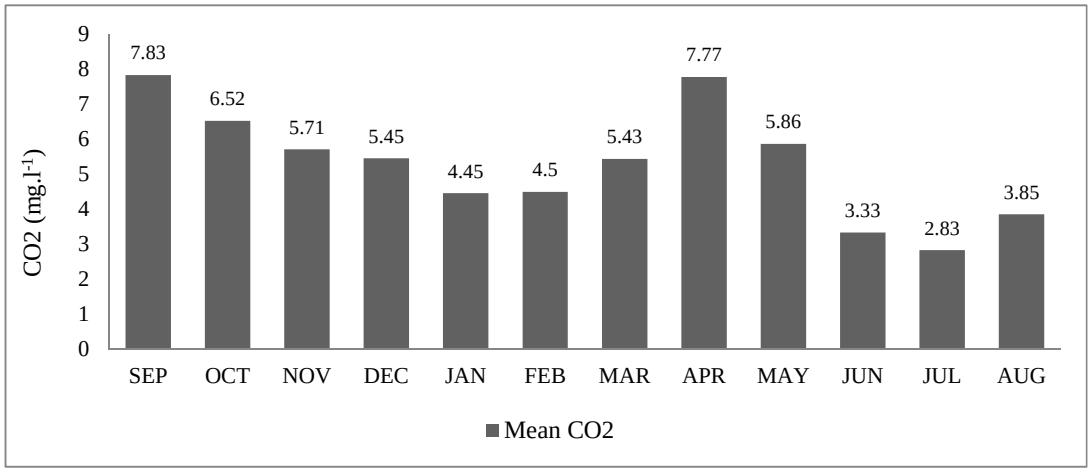

FIGURE 14. Free CO_2 of total studied region of Hooghly River

Level of free carbon dioxide was found to be highest in September (7.83 mgl^{-1}) during monsoon and lowest in July (2.83 mgl^{-1}) (Fig.14). Similar pattern of level of free carbon dioxide was also recorded by Joshi *et al*. (2009) in the water of river Ganga at Haridwar. That was probably due to flow of huge amount of organic matter carried from land and other water bodies and degradation by microorganisms generates carbon dioxide and increases the level of free carbon dioxide (Kotoski, 1997). Lowest level of free carbon dioxide was recorded probably due to formation of bi carbonate in the water. Saksena *et al*. (2008) observed that the presence of free carbon dioxide facilitates the formation of stable bicarbonate and subsequently lowers the carbon dioxide level in the water. Moreover, in some months at all study stations except Station D, free carbon dioxide crossed the tolerance limit of 6 mgl^{-1}.

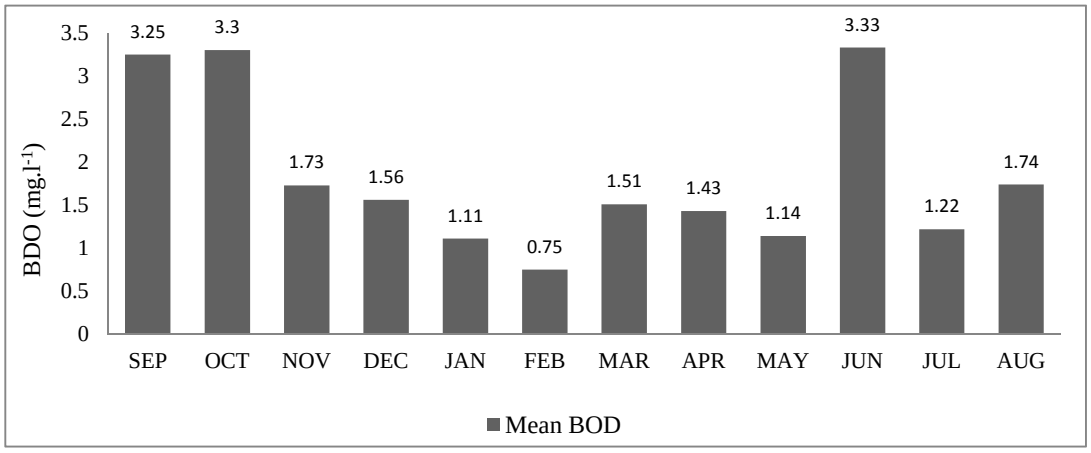

FIGURE 15. BOD of total studied region of Hooghly River

BOD level of the Ganga water was high during September –October *i.e.* monsoon and just after monsoon, and reached minimum level between December and February in almost all study stations (Fig. 15). Such high BOD levels was probably due to increasing organic matters in the river water during monsoon as well as due to dead algae and animals that have died over the winter were decaying in monsoon. In the lower gangetic plain, microorganism's population increases in late winter, then activity gradually increases towards the summer and monsoon. It helps to degrade organic matter by the consumption of oxygen, so DO level is decreased in the months of summer, subsequently increase the BOD of water (Kumar *et al.*, 2009). The study also revealed a sudden increased in free CO_2 and BOD level in water during the month of March-April. That was probably due to Hindu festivals like Charak, Nilsasthi *etc*. occurred during these months and huge amount of used flowers and leaves are thrown on the river side. Decay of those organic substances might during that period, raise the BOD level of those places. From the analyses it is evident that pollution is taking place in the river Hooghly regularly and if proper conservation measures are not taken, the condition of the river will likely to further deteriorate.

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