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Assessment of Seasonal variations in oxygen demanding parameters (DO, BOD, COD) along Sirhind Canal passing through Moga, Punjab, India

Simerjit Kaur [1] & Jasvir Kaur [2]

[1]Corresponding author: Associate Professor, Department of applied Sciences, Rayat-Bahra University, Mohali, Punjab, India,

[2]Research Scholar, Department of Botany, Jodhpur National University, Jodhpur, Rajasthan, India.

Abstract

During these investigations, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) & Chemical Oxygen Demand (COD) were analyzed in summer, monsoon & winter season to assess the water quality of Sirhind Canal passing through Moga, Punjab. DO was found to be decreased in summers but has shown elevated values during monsoon. Decreased DO level in summers can be attributed to increased temperature in summer. BOD & COD was high during summers following by winter & monsoon. A high BOD value indicates the presence of a large number of microorganisms, which shows a high level of pollution. COD is preferable to BOD because it is a rapidly measurable parameter. The higher the COD, the higher is the water pollution.

Keywords: water assessment, Sirhind canal, water analysis, water analytical techniques, DO, BOD, COD.

1. Introduction

1.1 River Water Pollution

Of all the Earth's ecosystems, rivers are the most dynamic having as their primary functions the transportation of water [1]. Rivers and their landscapes are complex ecosystems that can be seen as an interaction between five main components: physical habitat, flow regime, the energy or food base of the system, biological interactions and water quality. All contribute to the maintenance of the biological or ecological integrity of the system which refers to the capacity to support and maintain a balanced, integrated, and adaptive biological system having the full range of elements and processes expected in a region's natural habitat [2]. River pollution becomes apparent at times during accidents through horrifying scenes of dead fish floating on the surface of water. But more often, it exists as chronic and insidious pollution originating from different human activities. Pollution causes a general deterioration in the state of health of rivers across the entire planet. The growing problem of river pollution has necessitated the monitoring of the Water quality of the river in different states of our country to restore the waste quality.

A review of literature reveals that various studies have already been carried out by different workers in studying the various physio-chemical and biological parameters of Indian rivers and this work is briefly reviewed here [3-11].

2. Methodology

2.1 Geographical Location

Sirhind canal in Punjab, India, opened in 1882, irrigates more than 2,000 square miles (5,200 square km) of farmland. The system's headworks, where it draws its water, are on the Sutlej River at Ropar, near the border of Himachal Pradesh state. From there the canal runs west-southwest to Doraha, where it splits into three branches. One flows west and then northwest to rejoin the Sutlej near the Pakistan border; one runs southwest past Batinda to the border of Rajasthan state; and the third flows southeast to Patiala. There are many distributaries, in addition to the three principal branches. During this study, samples were collected in summer, winter & monsoon season in 2012 for the ten selected sites of Sirhind River flowing through Moga, Punjab: Raunta, Mardi Mustafa, Bhaga Purana, Sivian, Daatewala, Langian, Bhalour, Phulewalan, Ranian & Daudhar.

2.2 Sampling

Water samples were collected in triplicates from the ten sampling stations during the year 2012 for three seasons i.e. summer, winter & monsoon season. Polyethylene bottles were used to collect the water samples. The purpose of sampling was to handle the water sample very carefully in such a way that no significant changes occur in composition before the tests are made. The bottles were properly labeled with the sample number and date of sampling and were put in the bag to carry them to the area of testing. The bottles were tightly closed after being filled & stored at room temperature.

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Table-1: Methods used during these investigations

Parameters	Method used for estimation/Instrument
Dissolved Oxygen	Winkler's method
Biological Oxygen Demand	Winkler's method
Chemical Oxygen Demand	Reflux Titration method

The standard methods [12] were adopted for these parameters. Data was statistically analyzed by using One Way ANOVA at 5% level of significance among various spot and different seasons.

2.3 Study sites

These investigations were carried on Sirhind Canal, a stretch of 50 miles of Sirhind canal covering 10 stations along its course in Moga, Punjab, to find out whether the water is suitable for drinking and other various purposes.

The different sampling sites were selected at a distance of approx. 4 km each, the names of which are as follows:

Sampling Sites: S-1=Raunta; S-2=Mardi Mustafa; S-3=Bhaga Purana; S-4=Sivian; S-5=Daate Wala; S-6=Langiana; S-7=Bhalour; S-8=Phule Walan; S-9=Ranian; S-10=Daudhar.

3. Results & discussion

3.1 Dissolved Oxygen (DO)

The DO in the surface water is important parameter because it indicates the status of biological degradation of sewage by aerobic and anaerobic microorganisms while the former require free oxygen, the latter can react with the chemically bound oxygen from nitrates & sulphates etc. DO levels of 6 mg/l are considered optimal for proper growth of fish and other aquatic life. As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress. Most fishes cannot survive for prolonged periods at DO levels below 3 mg/l. Oxygen-demanding organic matter particularly requires the oxygen from water for the process of decomposition. More organic waste in water results in to decrease in average DO concentrations. However, in water bodies where a large proportion of the organic matter is brought in from outside the water bodies, the oxygen production and consumption are not balanced and DO may decrease [13].

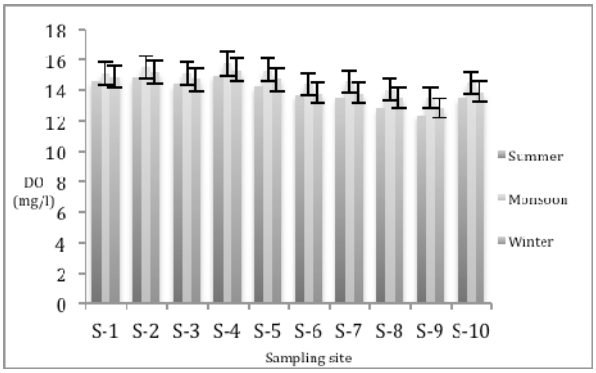

Fig. 3.1-Seasonal variations in concentration of Dissolved Oxygen (DO) in Sirhind Canal, Moga, Punjab

Fig. 3.1 reveals that in summer, DO ranged between 12.4-15 mg/l with maximum value at S-4 (15 mg/l) followed by S-2 (14.8 mg/l), S-1 (14.6 mg/l) & S-3 (14.4 mg/l) and minimum value at S-9 (12.4 mg/l). In monsoon, DO varied between 13.5-15.8 mg/l showing maximum value at S-4 (15.8 mg/l) followed by S-2 (15.5 mg/l) & S-5 (15.3 mg/l) and minimum value at S-9 (13.5 mg/l). In winter, DO varied between 12.8-15.3 mg/l with maximum value at S-4 (15.3 mg/l) followed by S-2 (15.2 mg/l) & S-1 (14.9 mg/l) and minimum value at S-9 (12.8 mg/l). Increased DO level during monsoon is in accordance with the research findings [14-16]. Increased value of DO during monsoon was attributed to the addition of freshwater in rainy days. An ideal DO value of 5.0 mg/L is the standard for drinking water [17]. DO was found to be in permissible limits at all the study sites among various seasons, therefore water is of good quality for aquatic life. Significant variations ($p<0.005$) were observed among various seasons.

3.2 Biological Oxygen Demand (BOD)

BOD is the amount of the oxygen required by microorganisms for the decomposition of the organic matter present in water. Therefore, it reflects the amount of organic pollutants in water. A high BOD value indicates the presence of a large number of microorganisms, which shows a high level of pollution [18]. It involves the measuring of differences in oxygen concentration in the water sample before and after incubating it for 3 days at 27ºC.

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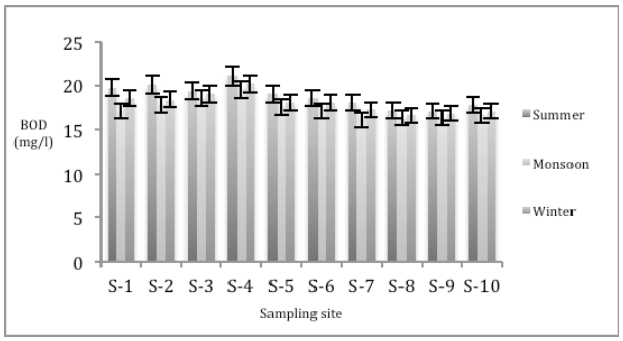

Fig. 3.2-Seasonal variations in concentration of Biological Oxygen Demand (BOD) in Sirhind Canal, Moga, Punjab

Fig. 3.2 reveals that BOD was high during summers following by winter & monsoon. In summer, BOD ranged from 17-21 mg/l with maximum at S-4 (21 mg/l) followed by S-2 (20 mg/l), S-1 (19.7 mg/l) & S-3 (19.3) and minimum at S-3 (19.5 mg/l). In monsoon, BOD varied from 16.1-19.5 mg/l with maximum at S-4 (20.1 mg/l) followed by S-3 (18.5 mg/l), S-2 (17.8 mg/l), S-5 (17.5 mg/l) and minimum at S-9 (16.3 mg/l). In winter, maximum, BOD varied from 17-20.1 mg/l with maximum at S-4 (20.1 mg/l) followed by S-3 (19 mg/l), S-1 (18.5 mg/l), S-2 (18.3) and minimum at S-8 (16.6 mg/l). Significant variations ($p<0.005$) occur between summer & monsoon and summer & winter. High BOD in summer and low in winter is in accordance with the findings [19-20].

3.3 Chemical Oxygen Demand (COD)

COD is the measure of pollution in aquatic system. High COD may cause oxygen depletion on account of decomposition of microbes [21] to a level detrimental to aquatic life. It is the amount of oxygen present in the water that is required or used in various chemical reactions (mainly oxidation) occurring in the water. Chemical oxygen demand (COD) is used as a measure of oxygen requirement of a sample that is susceptible to oxidation by strong chemical oxidant.

Fig. 3.3 shows that COD was maximum in summer followed by winter & monsoon. In summer, COD varied from 18.5 -21.5 mg/l with maximum at S-3 (21.5 mg/l0 followed by S-4 (21.2 mg/l), S-2 921 mg/l) and S-1 (20.5 mg/l) and minimum at S-1 (20.5 mg/l). In monsoon, COD varied from 18-19.5 mg/l with maximum at S-4 (19.5 mg/l) followed by S-5 (19.3 mg/l), S-6 (19.2 mg/l), S-3 (19.1 mg/l). Insignificant variations were observed among these sites. In winter, COD was maximum at S-4 (20.1 mg/l) followed by S-3 (19.3 mg/l) & S-1 (19 mg/l) and minimum at S-9 (17.6 mg/l). The high value of COD encountered in all of our selected study sites of Sirhind Canal, above the permissible limit of WHO (10 ppm), indicates the pollution by degradable organic wastes from various sources. Data has shown significant variations ($p<0.005$) among various seasons.

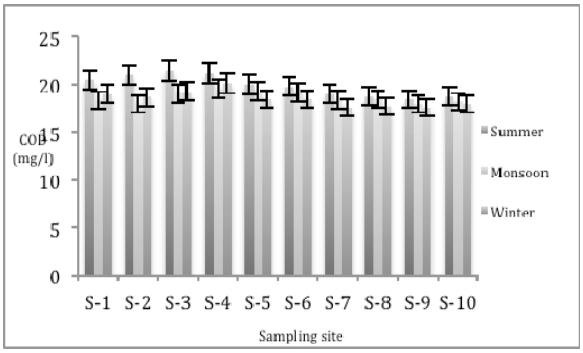

Fig. 3.3-Seasonal variations in concentration of Chemical Oxygen Demand (COD) in Sirhind Canal, Moga, Punjab

4. Conclusion

It can be inferred from above findings that decreased dissolved oxygen & elevated levels of BOD & COD have shown organic matter presence in Sirhind Canal that might carry disastrous effects on aquatic life & human health. Though DO was found to be in permissible limits at all the study sites among various seasons but elevated levels of BOD & COD is worrisome. BOD has shown significant variations ($p<0.005$) between summer & monsoon and summer & winter. The high value of COD encountered in all of our selected study sites of Sirhind Canal, above the permissible limit of WHO (10 ppm), indicates the pollution by degradable organic wastes from various sources.

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First Author

Dr. Simerjit Kaur has got her Ph. D & M.Phil degree from Punjab University, Chandigarh. She has been working as an associate Professor at Rayat-Bahra University, Mohali, Punjab, India in the department of applied sciences. She has more than 10 years of teaching experience. Her research work has been recognized by her various International publications. She has also been working as an associate editor for well-reputed International Journals.

Second Author

Ms. Jasvir kaur has been pursuing Ph.D from Jodhpur National University, Jodhpur, Rajasthan. Her research area includes physio-chemical analysis of Sirhind canal, Moga, Punjab, India. She has been working as an assistant professor at Lopon college of education, Moga, Punjab, India. She has more than 10 years of teaching experience.